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climate. When he feels the chill blasts he quirls down on a leaf and before it is passed he is pa- He keeps unsuitable hours and never the hive. In this way multitudes

es accustomed to a northern feeling the col nt

Th

Yan ircum- st s, buil traordinary size, and rearing dest columns of golden wax. That honey was another pleasing evidence of the superior capacity of California to produce the riches and luxuries of all climes.

The Grasshopper Plague.

EDITORS CALIFORNIA CHRONICLE: —The appearance and ravages of this insect are indeed of the most serious character, and it is of moment that every means that human forethought can devise, or careful observation can note that will tend to check or destroy the march of this desolating plague, should be as widely disseminated as possible. The evil is upon us—not upon a small garden-plat, a single orchard or grain field, or even an entire county—but it is becoming universal.

The last few days brings us accounts from many new sections where this evil, or calamity, more properly speaking, is now spreading disappointment and ruin throughout the Sacramento valley, far and near; few if any escape—some lose all—all bear some loss.

We have received letters from Colusi, Shasta, Ione Valley, and they are consuming all before them, marking their pathway by desolation. From the Putah Creek one of the brothers Wolfskill has just called on us, and informs us that their loss in crops will be near $10,000.

From every source we learn that irrigation at night, and showering the trees and vines, have in many instances driven them away. Heavy shades and awnings serve to protect and save. Grounds that are low and damp, and such as, by constant cultivation, give forth a dew at night, this insect avoids.

Shade and moisture they avoid; a hot and dry location they select, and the hotter the day the more terrible their ravages; the hottest days they move with more rapidity.

No one not familiar with their progress can have any conception of the immense quantities now in this vicinity. For the last three days the very air has been full of them over this city, resembling a dense snow storm—the myriads as they fly shining in the sun like snow flakes. So numerous are they, it is believed that were all which are floating in the heavens above to drop upon this city for even twenty-four hours, everything animal or vegetable would cease to exist, unless sheltered in close rooms.

Instances of animals being alarmed by the masses that light upon and bite them, and men traveling upon stages and otherwise have felt their sting and inconvenience. They seem to be on the increase, and extending their ravages—large fields of wheat and oats have suffered in the vicinity of Ione and other upper valleys.

We most earnestly urge all to the frequent and free use of water, under and upon the vegetable —only let it be remembered "do this by night," so that the foliage shall be dry by day again.

It is important that all who obtain any fact that goes to help in this new trial to this important interest should make it known, and we know the press will cheerfully lend its aid.

With respect, yours, WARREN,
California Farmer.
Sacramento, July 2d, 185 1855

A TUSK. A few days since there was taken out of Table Mountain, Tuolumne county, according to the Columbian, a large Tusk, measuring 4 feet 9 inches in length and 12 inches in circumference. It was so much decayed that upon exposure to the air it crumbled to pieces. The same gravel in which it was found has paid as high as twenty-four ounces to the hand per day, and is now doing well. June 1855

THE ELEPHANT ON A STEAMBOAT.—When the elephant went up the lake on the steamer Lady Elgin, a short time since, we remarked the huge traveller might be a somewhat ugly customer on board a boat. It appears that on the passage the wheelsman suddenly found difficulty in changing the boat's course. For, tug and jerk, and bear on as much as he would, the wheel would not budge an inch.

"Port helm," cried the captain.

"Aye, aye, sir," responded the wheelsman.

But still the helm was "hard a starboard," and the boat was taking a turn into the middle of the lake. The captain swore, and the mate made for the wheel-house. Pushing the man aside, he took hold himself. It was of no use—the mate was no more successful than the wheelsman.

"Port helm! for God's sake! Can't you see where the boat is going?" shouted out the captain.

The mate declared that something was the matter with the wheel, as he could not stir it. The thing was perfectly inexplicable. The engine was stopped, and master, mate and all hands went below to see what could be the matter. After a search of some minutes, it was discovered that Mr. Siam, the "elephant" of the menagerie, not liking the noisy rattling of the chains overhead, had taken upon himself the responsibility of giving a new "turn" to affairs. With his trunk wound around the chain he was holding on with the grasp of a vice, and it was with some difficulty that the keeper persuaded him that such liberties could not be allowed. It is said that he behaved well during the rest of the voyage.—*Buffalo paper.*

FISH IN THE ARTESIAN CREEKS.—Mr. Dabney showed us last week three beautiful little fish taken from his Artesian creek.

In shape these fish resemble the bass, and are very red under the mouth and belly, and have shaded stripes of a dark brown color on the sides. They have been kept for a week or more in a tumbler of water, where we noticed them feeding on the crumbs of bread. Mr. Dabney says that they have grown very fast since they were first taken. There is no doubt that these fish came from the subterranean stream through the Artesian pipes to upper earth. Mr. Dabney says that one of them was found in a bucket which was set under the spout of the Artesian well.

In many of the Artesian creeks at San Jose these fish have been found; but in Distillery creek, which flows past our domicil, none have been discovered—the "Native American" element from that manufactory probably not being congenial to the life of fishes.—*San Jose Telegraph.* 31 Dec/55

1855

A DOG'S AFFECTION FOR HIS MASTER.—Mr. O. M. Hopkins, late of Scottsburg, who died in January last, had a small and sprightly terrier, named "Nig," of which he was very fond. After the death of his master, Nig grew melancholy. Nothing the family could do seemed to amuse him. He could not be enticed from the side of his mistress but would follow her about everywhere, grave and sedate, as though actually thinking of his dead master. One day a closet containing his master's clothing was opened. No sooner did Nig discover the garments than he frisked about almost frantic with delight, evidently expecting his master to appear. When the poor animal discovered his error, he testified his disappointment by piteous and mournful howlings. In May last, poor Nig grew more melancholy than ever. All attempts to induce him to leave the house were unavailing, until one day his mistress went to visit the grave of her husband. Then he followed, and on arriving at the mound commenced digging and moaning, testifying his grief in the most affecting manner. From that time he could not be enticed to leave the grave, but stayed day and night, till he starved to death. He was found there, stretched on the earth, cold and stiff.

Southern Calif...

WILLIAM BUTTS & JOHN O. WHEEL... EDITORS.

LOS ANGELES, JULY 11, 1855.

Tremendous Shock of an Earthquake.

Last eveniug at about half-past seven was experienced the heaviest and most tremenduous shock of an earthquake ever known in this country and one that will be long remembered in this section, such was its force that large numbers of our one story buildings were cracked from top to bottom, glass and crockery were thrown from the shelves, windows broken, etc., etc. Nearly every merchant in this city suffered quite severely in this manner. Lamps were upset, families seated at the tea-table were dismayed to witness the sudden overturn of tea-urns and dishes and fled affrighted to the open air. Clocks were thrown down. Indeed, hardly a building escaped without damage to its walls, or destruction of some portion of its contents. The shock lasted several seconds and appeared to lift up and twist the ground about, accompanied by a roaring noise like the approach of a hurricane.

The weather during the day had been somewhat cloudy and very unusual for this season.—There was a slight fall of rain about 11 A. M.—The movements appeared to come from the east, althongh its suddenness rendered it impossible to determine with any accuracy its direction. Los Angeles never took as thorough a purge before,—every house was deserted in a trice. There can be no doubt that had our city been composed of three and four story buildings, it would have been levelled with the ground. Our buildings are geuerally but one story, however, and to this fact are we indebted for our escape from what might have been a fearful catastrophe. As it was walls of two and a half and three feet in thickness, were rent asunder, and a general ripping and crackling took place that created universal consternation and brought Miller's prophecies vividly to mind. Our citizens are busily engaged today in repairing damages in readiness for another shake.

☞ Such immense swarms of locusts have latterly visited Odessa, that the city is described as being completely darkened with them. Great damage has been occasioned by them this year throughout the whole of southern Russia.

THE KAISER AND THE POPE.—A *concordat* has been signed between Austria and Rome. Judas has kissed Barabbas.

☞ Envy is defined as punishing one's self for being inferior to one's neighbor.

Cal. Chronicle Nov. 9/55

"WHERE DO THE SPONGES GO?"—They are too large to be soncealed, and too remarkable to be overlooked; and yet, year after year, we are shipping from twenty to thirty tons of sponges—or about twenty-five millions of separate sponges to the New York market—without any knowledge of what becomes of them. We have seen cloth, hats and shoes—all said to be made of the sponge—but we don't believe a word of it. The demand and the price for this article have steadily increased with the supply. Twelve and a half cents per pound were given for them but five years ago, and now, though the quantity shipped has steadily increased, forty cents per per pound are readily obtained, and the demand increases. The value of the last year's shipment has been $15,000.—*Key West (Florida) Key of Gulf.*

Dec. 1855

THE SUN.

OFFICE, No. 130 WASHINGTON STREET.

SATURDAY, DECEMBER 15, 1855.

WORM EATEN.—Several piles have been removed from the water in the vicinity of Meigg's wharf, and were found to be thoroughly honey-combed—the effect of worms. The destructiveness of these worms has already rendered useless many thousands of piles in this harbor, and in many instances, a complete set of new piles have been driven, or a resort had to filling in the water lots with earth. In many of the South American ports, and we believe, in one or two instances in San Francisco, the piles are specially prepared, either by covering them with copper, or some kind of coating, to resist the worm which bores into the hardest timber and speedily render the wood unfit for the purpose intended.—An old hulk lying off Rincon Point, was recently broken up and in places where the copper had been worn off, the wood is perforated in every direction by the worms. There is no apparent remedy against the evil except the one mentioned.

REMAINS OF A MASTODON.—Messrs. Stearns & Stevens, of Shaw's Flat, have shown the editor of the Sonora Democrat an immense tusk, taken from the mining claim of the first named gentleman, on the 3d instant, about five or six feet below the surface. The tusk was supposed to be, when perfect, about nine feet in length, the portion exhibited being three or four feet from the point, and in a very good state of preservation. A great many fragments of the animal had been found from time to time in the same vicinity, but not enough sufficiently preserved to form a conception of its character and vast proportions. June 14, 55

MAMMOTH REMAINS.—The editor of the Sonora *Herald* has seen a portion of a tusk, originally over four feet in length, which was taken from the Pioneer Table Mountain Tunnel, owned by Messrs. Lyons, Oliver, Streeter & Co. The portion seen by us is in a tolerable good state of preservation, and was taken out more than one hundred feet below the surface. Hoofs and other bones, of mammoth size, were also found in the same locality, furnishing unmistakable evidence of the existence, in this region, at a former period, very remote, of a class of animals very different from any now known.

NEW-YORK AS A GAME MARKET.—We question whether there is a market in the world supplied with as great a variety of wild game as the City of New-York. Not only do the vast regions of the West and the Canadas afford their contributions, but wherein they fail Europe is drawn upon to make up the deficiency. All descriptions of good game brought to market are readily bought up. Nov. 1855

VENISON may be placed at the head of the list of choice game. The carcasses are generally forwarded from different points at the West, in a frozen state, and meet with ready sale.

WOODCOCK brings the highest price of any bird brought to market, and is to be had from the 1st of July to about the 1st of December. It is estimated that about 40,000 are brought to the City during the season of which 15,000 are received at Fulton Market. Prices range from 40 cents to $1 per brace, and average say 75 cents.

PARTRIDGES or PHEASANTS are seen from September to the 5th of January, when their sale is prohibited by law. Like the woodcock this choice bird is to be found in all the surrounding country, but especially in the Eastern States. At least 300 are brought to the City per day, or say 36,000 during the four months—average price 75 cents.

QUAILS bring from $1 50 to $2 50 per dozen during the Fall months, but during the Winter, when they may be tracked on the snow, they are taken in immense quantities in the Western States, and brought to the City by tuns; average price, $1 per dozen.

GROUSE and PRAIRIE HENS come exclusively from the West. In Winter they are very abundant, when they are trapped in great numbers, and sell as low as 50 cents and $1 per pair. It would be impossible to compute the number brought to the City, but one dealer in Fulton Market has bought at one transaction to the amount of $1,100.

HARES are to be found in Canada, and some few in this State; also in Rhode Island. In Winter their skin is perfectly white. The animal is not so highly esteemed here as in England. Price, about 50 cents per pair. About 3,000 are annually brought to the City, mostly from the British Provinces. The small gray rabbit is quite plentiful all around us, and probably some 10,000 are brought to market in the season. Average price 37½ cents a pair.

PLOVER AND SNIPE.—Of this tribe there are some six or eight kinds, and there are probably 10,000 dozen sold here during the year.

At least 10 to 15 per cent of all the game attempted to be brought to this market is lost on its way, either from changes in the weather or ignorance on the part of those forwarding it. The latter often [illegible] loose assault. They average from 75 cents to $1 per pair. Wild Geese are very abundant. Some seasons probably 3,000 to 5,000 are killed for this market, and bring, on an average, $1 per head. Brant are probably the best salt water Duck. We have them in the Spring and Fall from Long Island, and sometimes during the Winter from the South. They are of a delicate construction, and are unable to endure the cold of a Northern climate. About 5,000 are sold here at from 75 cents to $3 a pair. In May they are very fat, and the best duck at that season. The Mallard is another very fine duck, found on our lakes and rivers. About 2,000 are brought to this market. The Black Duck, Widgeon and Broad-bill, abundant in our waters, especially on the sea shore, are scarcely inferior in quality. They are to be found in the market from Fall till late in the Spring. About 30 000 are annually sold here, at an average of 50 cents to 62½ cents per pair. We also receive from Virginia during the Winter months, an immense quantity of Virginia or Gray Duck, which are very fine. About 20,000 come to this market. The Blue and Green Tail is another duck in much demand, and of which about 5,000 are received.

WILD PIGEONS are very abundant at some seasons. There have arrived here in one day 2,000 dozen, and they will sell from 50 cents to $1 50 per dozen. The average number sold here each year is estimated to be 25,000 dozen, though the quantity varies widely in different years. One dealer in Fulton Market has received sixty barrels, or 1,500 dozen, in a single day, which had been caught in this State and Pennsylvania, and were forwarded over the Erie Railroad.

The European trade in American game is extensive, as the steamers afford a rapid and prompt means of transportation. Large quantities of canvas-back ducks are sent out, as nothing like it are to be had abroad. On the other hand, we import English pheasants, Scotch grouse, and occasionally a few hares. [Journal of Commerce.

HYDROPHOBIA.—It is no pleasure to a dog to go mad. Quite the reverse. Dreadful as hydrophobia may be to the human being, rabies is worse to the dog. It makes its approach more gradually. It lasts longer, and it is more intense while it endures. The dog that is going mad feels unwell for a long time prior to the full development of the disease. He is very ill, but he does not know what ails him. He feels dissatisfied with everything; vexed without a reason; and, greatly against his better nature, very snappish. Feeling thus, he longs to avoid all annoyance by being alone. This makes him seem strange to those who are most accustomed to him. The sensation induces him to seek solitude. But there is another reason which decides his choice of a resting place. The light inflicts upon him intense agony. The sun is to him an instrument of torture, which he therefore studies to avoid—for his brain aches, and feels as if it were a trembling jelly.

This induces the poor brute to find out the holes and corners where he is least likely to be noticed, and into which the light is unable to enter. In solitude and darkness he passes his day. If his retreat be discovered, and the master's voice bid him to come forth, the affectionate creature's countenance brightens, his tail beats the ground, and he leaves his hiding place, anxious to obey the loved authority; but before he has gone half the distance, a kind of sensation comes over him which produces an instantaneous change in his whole appearance. He seems to say to himself: "Why cannot you let me alone? Go away! Do go away! You trouble me—pain me!" And thereupon he suddenly turns tail and darts back into his dark corner. If let alone, there he will remain; perhaps frothing a little at the mouth, and drinking a great deal of water, but not issuing from his hiding-place to seek after food. His appetites are altered; hair, straw, dirt, filth, excrement, rags, tin shavings, stones, the most noisome and unnatural substances, are then the delicacies for which the poor dog, changed by disease, longs and swallows, in hope to ease a burning stomach. He is most anxious for liquids. He is now altogether changed [illegible], not in his bite, simply considered, terrible. He cannot pause to tear the creature he has caught. He snaps and then rushes onward, till, fairly exhausted, and unable longer to follow, he sinks down and the sheep pass forward, to be no more molested. He may have bitten twenty or thirty in his mad onslaught; and would have worried more, had his strength lasted—for the *furore* of madness then had possession of him. He may be slain while on these excursions; but if he escapes, he returns home and seeks the darkness and quiet of his former abode. His thirst increases, but with it comes the swelling of the throat.

He will plunge his head into water, so ravenous is his desire; but not a drop of the liquid can he swallow, though its surface is covered with bubbles in consequence of the efforts he makes to gulp the smallest quantity. The throat is enlarged to that extent which will permit nothing to pass. He is the victim of the most horrible inflammation of the stomach, and the most intense inflammation of the bowels. His state of suffering is most pitiable. He has lost all self-reliance; even feeling is gone. He flies at and pulls to pieces anything that is within his reach. One animal in this condition being confined near a fire, flew at the burning mass, pulled out the live coals, and in his fury scrunched them. He emits the most hideous cries. The noise he makes is incessant and peculiar. It begins as a bark, which sound, being too torturing to be continued, is quickly changed to a howl, which is suddenly cut short in the middle; and so the poor wretch at last falls, fairly worn out by a terrible disease. —*Mayhew's Dogs.*

e Man-Monkey of Brazil.

The captain of the French schooner *Adrienne*, who last summer was stationed at Pernambuco, Brazil, gives the following sketch of a tame monkey t

A short time ago I dined at a Brazillian merchant's. The conversation turned upon the well tutored chimpanze of Mr. Vanneck's, a creole gentleman, whose slave had brought him the monkey, which he had caught in the woods. Every one praised the accomplished animal—giving accounts of its talents so wonderful that I could not help expressing some incredulity. My host smiled—saying I was not the first who would not believe in these results of animal education until he had seen it with his own eyes. He therefore proposed to me to call on Mr. Vanneck.

I gladly consented, and on the following morning we set out. The house of the Creole lies on the road to Olinda, about an hour's ride from town. We proceeded along splendid hedges of cactus shaded by the bananas and palm trees, and at length observed his charming villa. A negro received us at the entrance and took us to the parlor—hastening to tell his master of our visit. The first object which caught our attention was the monkey seated on a stool and sewing with great industry. Much struck, I watched him attentively, while he, not paying any attention to us, proceeded with his work. The door opened; Mr. Vanneck, reclining on an easy chair, was wheeled in. Though his legs are paralyzed he seems bright and cheerful; he welcomed us most kindly. The monkey went on sewing with great zeal. I could not refrain from exclaiming "How wonderful!" for the manner and process of the animal were those of a practical tailor. He was sewing a pair of striped pantaloons, the narrow shape of which showed that they were intended or himself.

A negro now appeared—announcing madame Jasmin, whom Mr. Vanneck introduced as his neighbor. Madame Jasmin was accompanied by her little daughter, a girl of twelve years, who immediately ran to the monkey—greeting him as as an old friend, beginning to prattle with him. Jack furtively peeped at his master; but as Mr. Vanneck's glance was stern, the tailor went on sewing. Suddenly his thread broke; and he put the end to his mouth, smoothed it with his left paw, and threaded the needle again. Mr. Vanneck then turned to him, and, speaking in the monkey drew it from my pocket and handed it to me. "Now show your room to my guests," continued his master; and he opened a door at which he stopped to let us pass, and then followed himself. Everything was extremely tidy in the small room. There was a bed with a mattress; a table, some chairs, drawers, and various toys; a gun hung on the wall. The bell was wrung; Jack went and reappeared with his master, wheeling in the chair. Meanwhile I had taken the gun from the wall; Mr. Vanneck handed it to the monkey, who fetched the powder-flask and shot-bag, and in the whole process of loading acquitted himself like a rifleman. I had already seen so much that was astonishing, that I hardly felt surprised at this feat. Jack now placed himself in an open window, took aim and discharged the gun without being the least startled by the report. He then went through sword exercise with the same skill.

It would be too long to jot down all Mr. Vanneck told us about his method of education and training; the above facts, witnessed by myself, bear sufficient evidence of the abilities of the animal, and its master's talents for tuition. We stayed to supper, to which there came more ladies and gentlemen. Jack again exhibited his cleverness in waiting, at which he acquitted himself as well as any man-servant. Going home my companion missed a small box of sweets, out of which he had regaled the monkey with almonds. Jack had managed to steal it from his pocket; and on being afterwards convicted of the theft was severely punished by his master.—*Chambers' Jour.*

THOS. K. DOWNING, City Inspector.
CITY INSPECTOR'S OFFICE, New-York, Nov. 17, 1855.

Wild Beasts at Auction—Great Sale at the Hippodrome.

The sale of the remainder of wild beasts of the American Menagerie at the Hippodrome on Monday, was not so well attended nor so spirited as was expected. The attendance was doubtless affected somewhat by the advertised requirement of one shilling for admittance; and bidders were probably in some fear that a purchase would place them in the unenviable position of the indiscreet gentleman who bought an elephant and had no place, with the exception of a small carpeted back parlor, to keep him in.

When the hour arrived at which the sale was advertised to commence, Mr. A. C. TUTTLE, the auctioneer, proceeded to dispose of the animals in as cool and every-day business-like as if he were knocking down second-hand furniture, or retired omnibus horses. The first animal offered for sale was a large white bear said to be the only one living in America; and if the price at which he was sold is a fair criterion by which to judge of the general estimation in which these Polar gentlemen are held, it is not probable that another will voluntarily leave his dear native ice, to become a wandering exile in America, for many years to come. Mr. E. M. SHIELDS was the only bidder present who evinced anything approaching to an adequate appreciation of the value of his society; and to him the only living white bear was knocked down for the sum of $475, cage and all. His bearship heard himself disposed of with as little apparent concern as hardened criminals exhibit on hearing a sentence that they be hanged by the neck. His only expression was that he had a feverish desire for a nice clean piece of ice.

Royalty went at a still lower price. A Bengal tiger with a royal title, fierce expression of countenance, huge paws, and a powerful inclination to lie down, was sold to Mr. HENRY BUTLER for $225.

The next lot was two performing lions and a lioness, with their den. The lions were noble fellows; but, notwithstanding they shook their manes, wagged their tails, and roared majestically, they were knocked down, in their den, to Mr. H. BUTLER, for the insignificant sum of $375. The same gentleman purchased a zebra, a beautiful little leopard, and a cage, for $285.

The greatest insult ever offered to the race of forest kings was now given by a Republican Auctioneer. He put a lion and a hyena up for sale together. His majesty was sorely mortified—so much so that he lost his hair at the bare thought. Both were sold to Mr. BUTLER for $75—less than the cage cost when new. Mr. E. G. JARVIS purchased a lama, a grizzly bear and cage, for $150. The bear did

[illegible]

when Mr. JOSEPH CUSHING gave $575 for a rhinoceros.

The man who is generally known as He who bought the elephant, turned up again near the close of the sale, and, what is remarkable, had another man with him of a like propensity. As with all evil practices, so is it with elephant-buying—

"It grows by what it feeds upon."

This gentleman, who did not know what to do with one when he first went into the business, did, on Monday, in connection with the other man, buy four elephants—one of them Irish—for which the following sums were paid:

For elephant *Canada*	$1,400
For elephant *Fanny*	1,200
For elephant *Mogul*	1,100
For elephant *Mickey*	1,100

As the name of the elephant-buyer has heretofore been concealed from the public—nothing but his troubles having been made known—we have pleasure in being the first to announce, not only his cognomen, but that of his partners—Messrs. E. F. & J. MAYBEE. Maybe they won't thank us for publishing their card, but duty compels us to do it.

The sale of a camel, now in Ohio, on condition that the purchaser pay for his keeping from Aug. 20 to the present date, concluded the interesting portion of the auction. He was bought by Mr. THOMAS SMITH for the sum of $10.

A portion of the draft-horses were next sold. They brought from $80 to $75 a-piece.

Fires.

Earthquake Waves on the Coast of California.

Sept. 1855

At the American Association for the Advancement of Science, which met last month at Providence, R. I., Professor A. D. Bache read a paper on the Earthquake Waves which took place on the Western Coast of the United States on the 23d and 28th of December, 1854. The following report on the subject appears in the N. Y. *Tribune* of August 20th:

On the 23d of December, 1854, at 9 A. M., an earthquake occurred at Simoda, on the island of Niphon, Japan, that resulted in the wreck of the Russian frigate *Diana*. The harbor was first emptied of water; then came in an enormous wave, which again receded. (It appeared from the Rev. Mr. Jones that the whole character of the harbor of Simoda, previously surveyed by the *Powhattan*, has been changed by the earthquake.) A report from the Bonin Islands is not sufficiently exact to use for our main purpose, but points to Simoda as the centre of disturbance. (Simoda, according to Mr. Jones, is volcanic; Bonin appears not to be.) Now the Coast Survey has three self-acting tide-guages, at Astoria, on Columbia River, San Francisco, and San Diego. They record the rise of the tide on a cylinder turned by a clock. The apparatus is protected more or less from the oscillations that wind-waves would cause, which only cause a trembling of the index or stylus. The guage at Astoria was but slightly affected by the earthquake wave, owing to the bar on the river and the distance it had to ascend. At San Francisco, 4,800 miles from Simoda, the wave arrived 12 hours 16 minutes after the beginning of the earthquake. A series of seven waves, each about half an hour in duration, or 35 minutes, each series successively smaller, and separated by a quiet time of an hour from the preceding, was recorder at San Francisco. At San Diego the wave had traversed 5,200 miles in 12 hours 38 minutes, and produced likewise a series of seven waves, each nearly corresponding to those at San Francisco, but the second series stronger than the first and third. In height they were less, the highest at San Francisco being .7 of a foot, at San Diego

The waves at San Diego could not have come om San Francisco, as they would have arrived much later. The velocity with which a wave travels depends on the depth of the ocean. The second and third series were but repetitions of the first wave that had reached the same points, traveling through shallower water. The calculations based on these data give for the Pacific Ocean a depth of from 14,000 to 18,000 fathoms. It is remarkable how the estimates of the ocean's depth have grown less. La Place assumed it at 10 miles, Whewell at 3.5, while this estimate brings it down to about 2 miles.

Sept. 1855

The Pacific Mastodon.

We have now lying upon our table a fossilized mammoth grinder of the Mastodon Maximus, which was found in a small branch at Canemah, by Mr. Saml. K. Barlow. The grinder was perfect when discovered and weighed three pounds. No less than seven species of the Mastodon have been discovered in different parts of the world, three in Europe, two in South America, one in India, and one in the United States.

That which has been found in the United States is the largest specimen the world has ever produced, and has consequently received the name of Mastodon Maximus. In the Museum of Mr. Peale, of Philadelphia, there is a skeleton put up which measures fifteen feet in length, and eleven feet in height. The bones of the Mastodon have never been discovered further east than Burlington, Conn., whilst vast numbers of them have been found in the neighborhood of Big Bone Lick of Kentucky.

We have now the pleasure of announcing the first discovery of the kind on the Pacific coast by our old friend S. K. Barlow, who is known all over the Union as the old pioneer who cut the first wagon road through the Cascade Mountains. —*Oregon Argus.*

A Trout Fish Living in a Well Twenty-Five Years.—Mr. F. Hoyt, a correspondent of the Country Gentleman, writing from South East, New York, November 19th. says: 1855

Can any one tell how long a trout fish will live? Twenty-five years the past summer I came on the farm where I now am. Almost the first work that I did after getting in my spring crops was to drain a bog swamp, the outlet of which leads into the Croton river. I had an old Scotchman to do the ditching. One day he brought up a trout fish about the size of a man's little finger in his whiskey jug, (by the by we used a little on the farm then, and not since then.) I put it in the well near the house, and it is there now, grown to a goodly size—say about a foot long and large in proportion. It has been fed but very little; once in a while some one throws in a grasshopper or cricket, to see him catch it. The well is thirty feet deep and water hard, and settles down nearly to the bottom, and then again rises to near the top. He has been taken out a few times to clean the well, but not for the last five years.

Friday last I got a grasshopper, the last one I expect to see this fall, and gave it to him. The water is now twenty-five feet deep, but it hardly touched the surface before he had it. If any one has a fish older than mine, I would like to know it.

Strange Animal—The Gorille.—A gentleman has furnished us with a translation of an article from a recent number of the *Echo du Pacifique*, giving the description of a most singular animal. That paper says: 1856

"Our French scientific newspapers, by last mail, brought us accounts exceedingly interesting, of a new kind of animal heretofore unknown, which was sent by a French *literate* to the Historical Museum, at Paris. It bears the name of the Gorille, and approaches very near the human species.

"None of the European menageries ever possessed a living Gorille, and the French museum is the first to possess a dead one. The animal curiosity was brought by Dr. Franquet from the coast of Gabon. The Gorille absolutely resembles the man, of which it has the proportions—but on a gigantic scale. It is as large as a giant. The legs are short, thick, and of enormous size. The bust long and herculean. The breast and shoulders are sixty inches in circumference. Its face is black, long and naked, with the exception of some gray hairs upon its lip and chin. Its head is covered with long stiff hair, which, from the forehead, rises directly on the skull, and reaching the nape of the neck, at which point it divides, and in short, resembling two branches of a crown. This moveable mane stands upright at will, and gives to the animal a ferocious look. Add to this two long arms—which may suffocate a man without the least effort—and hands sufficiently large to grasp the most voluminous hand of a man twice over. The Gorilles are of such strength, that ten men could not subdue a single one. Their principal force lies in the vigorous pressing of their hands, by means of which they quickly choke their enemy. Like those negroes who swallow their tongues that tuey may die free, the Gorille will not know slavery—it must be killed to be taken."

Is it so?—It is a popular belief that the age of trees can be determined by the "rings" or grains that overlie each other in their trunks. Mr. Joshua Howard, of Maryland, disputes the fact. He says that these rings counted on the section of the tree are not of annual growth—are formed one at every full moon in the growing season, and at the latitude of Maryland five a year. This he has frequently proved by felling trees, the age of which he knew. The extraordinary age given to trees by the popular rule has made many persons doubt whether it is true.

October 1856

Curious Plants.

Almost every body has heard of the wonderful walking leaves of Australia. For a long time after the discovery of that island, many people really believed that the leaves of a certain tree which flourishes there, could walk upon the ground. The story arose in this way:

Some English sailors landed upon the coast one day, and after roaming about until they were tired, they sat down under a tree to rest themselves. A puff of wind came along, and blew off a shower of leaves, which, after turning over and over in the air, as leaves generally do, finally rested upon the ground. As it was midsummer, and everything appeared quite green, the circumstances puzzled the sailors considerably. But their surprise was much greater, as you may well suppose, when, after a short time, they saw the leaves crawling along the ground towards the trunks of the tree. They ran at once for the vessel without stopping to examine into the matter at all, and set sail away from the land where every thing seemed to be bewitched. One of the men said that "he expected every moment to see the trees set to dance a jig." Subsequent explorations of Australia have taught us that these walking leaves are insects. They live upon the trees. Their bodies are very thin and flat, their wings forming leaf-like organs. When they are disturbed, their legs are folded away under ther bodies, leaving the shape exactly like a leaf, with its stem and all complete. They are of a bright green color in the summer, but they gradually change in the fall with leaves, to the brown of frost-bitten vegetation. When shaken from the tree, they lie for a few minues upon the ground, as though they were dead, but presently they begin to crawl along towards the tree, which they ascend again. They rarely use their wings, although they are pretty well supplied in this respect.

Another eccentric production of nature, which we find mentioned in Milner's Crimea, is the "Steppe Witch." 1855

This curious plant, which grows in the Crimea, is in that country the theme of many a tale and ballad of childhood. The plant rises to the height of three feet, and ramifies considerably upwards, so as to form a thick round bush, bearing pretty little flowers. When sapless and withered in autumn, the main stock is broken close to the ground by the first high wind that rises; and the rounded top is carried rolling, hopping and skipping over the plain under the conlrol of the breeze. Other small withered plants become attached to the mass, and it gradually forms a huge mishappen ball; while several being drifted together, adhere like enormous burrs, and have some witchery in their appearance, as they go advancing and bounding before the gale. Hundreds of these objects may be seen scouring the steppes at the same time, and may easily be mistaken at a distance for hunters and wild herds. Heavy rains put an end to the career of the witches; or the Black Sea, into which they are blown, summarily arrests their course.

Life Without Water.—The day before we reached the Orange river we fell in with a kraal of Hottentots, whom, to our great surprise, we found living in a locality altogether destitute of water. The milk of their cows and goats supplied its place. Their cattle, moreover, never obtained water, but found a substitute in a kind of ice-plant, (*mesembry-anthemum*,) of an exceedingly succulent nature, which abounds in those regions. But our own oxen, not accustomed to such diet, would rarely or never touch it. Until I had actually convinced myself—as I had often the opportunity of doing at an after period—that the men and beasts could live entirely without water, I should perhaps have had some difficulty in realizing this singular fact.—*Anderson's Wanderings in Southwestern Africa.*

THE DAILY UNION.

The Sperm Whale and its Food.

The full-grown male Sperm Whale is from sixty to seventy feet long, and not far from 30 feet in circumference in the largest part. The head in front is nearly square, or has the corners rounded off, and is much thinner next the lower jaw, becoming thicker towards the back, where it is almost as broad as the back, increasing a little in size up to the eyes, which are located abuut one-third of the whole length of the fish from the extreme end of the nose. The eyes are about twice as large as those of an ox, and have lids to shut over the ball. From this fact we may suppose it sometimes sleeps, although I never caught one so: the lid may serve to protect the eye from injury. Be this as it may, none but this species of whale, or such as breathe the atmosphere, have eyes with lids that can be shut.

From the eye, the body enlarges a little, until we come to the middle of the fish, and from here it tapers down to the tail or flukes, as whalemen call them. The flukes are about ten feet across, and lie horizontal when in natural position.

There is a large hump on the lower part of the back, and several small ones near the tail. There are two small fins, one on each side, just behind and below the eye; these fins are about three feet long, and one and a half wide. I think their only use is to steer with. The upper jaw is about fifteen feet long from the socket to the extreme end or point; the lower jaw is armed with large teeth, which stand apart separately; there are from twenty to twenty-five on each side. There are no teeth on the upper jaw; instead of them, cavities are provided, into which the lower teeth fit. The tongue is small, about two and a half feet long by one wide. The throat is small, and the fish could not swallow a man: therefore it was not a sperm whale that swallowed Jonah.

When feeding and not disturbed, the fish will stay down under water from one hour to one and a quarter. It then has to come up to the surface to breathe or spout, and it will stay up from ten to fifteen minutes. In this time it will spout or breathe from fifty to sixty times. It throws out no water when it spouts, as has been represented by some. At the end of this time it "turns flukes," or pitches and dives down.

This whale feeds entirely on the "squid," or cuttle-fish, as I believe they are sometimes called. The "squid," I think, lives by suction; it has no bones in its body, strictly so called; it has a kind of bill, short and thick in form,—something like horn or turtle shell in texture and color. It has two thin pieces of skin on each side, one at each end, or nearly so, and when small can fly a short distance, on the same principle as the flying-fish or squirrel, by impetus, always rising against the wind. It has long arms or fibres that extend forward from the fore part of the body, with which it embraces and holds whatever is intended as food. They grow to a very large size, and so strong as to drown a man by embracing him. This I was told did actually happen to a native of the Sandwich Islands while I was there. I have frequently seen large pieces of squid floating on the water, perhaps killed by the sperm whale. I saw a piece once, while sailing, which I judged to be ten feet in diameter. I have taken them from the whale's stomach, whole, from two to three feet in length.

[The writer of the foregoing article is a well known sea captain, and moreover, an inventor of much ingenuity. He relates his account of the sperm whale from his own observation while among them in the Pacific Ocean. His statement, therefore, may be looked upon as correct, besides being of much interest to the reader.—Ed.]—*Scientific American.*

SPERM WHALES.—The *Nantucket Inquirer* publishes the following extract from a letter recently received from Callao: "The bark Eliza, Captain Phillips, of Baltimore, reports that while in sight of Staten Land, to the northward, he sailed an entire day through large bodies of sperm whales, and as far as he could see, for miles around, the whole ocean was covered with them. Through the whole day he felt that his ship was in danger, as his deck was wet with the spray from their spouts, so near were they to his vessel. Captain Phillips is an old Rio trader, and having often seen sperm whales off the River La Platte, knows them well. He says the number was beyond conception." 1852

A CURIOUS STRUCTURE.—Dr. Hope has in his possession the nest of a tarantula, taken out of the earth at the Malaga Rancho. It is about three inches in length by two in diameter, built of adobes, the walls being nearly half an inch thick. Inside is a projection, which nearly divides it into two apartments, about an inch in diameter. The inside is lined with a white downy substance, not unlike velvet, and presents one of the cleanest and most tidy little households imaginable. But the most curious part of it is a door, which fits into an aperture and closes it hermetically. The door is secured by a hinge, formed of the same fibrous substance as the lining of the house, and upon which it swings with freedom. The nest is occupied by a dozen little tarantulas, which seem to subsist upon a yellow secreted substance that appears upon the walls of the front apartment. It is a most interesting structure, and the arrangement of the door for the protection of the little inmates indicates great instinctive architectural knowledge. It is the intention of the owner to forward this curiosity to the Smithsonian Institute, at Washington. 1854 Sonora

ALLIGATORS.—The *Sonora Herald* says that the workmen engaged on the Columbia and Stanislaus River Water Company's Tunnel, some few months ago came across the under jaw-bone of an alligator, imbedded at a depth or three hundred and fifty feet from the surface. Mar. 25/56

Jenyus, the English naturalist, states that he knew a tame owl so fond of music that he would enter the drawing rooms of an evening, and perched on the shoulder of the children, listen with great attention to the tones of the piano forte, holding his head first on one side, and then on the other, after the manner of connoisseurs. One night, after spreading his wings, as if it were unable to endure his rapture any longer, he alighted on the keys, driving away the fingers of the performer with his beak, began to hop about on the keys himself, apparently in great delight with his own execution.

A GRIZZLY THIEF KILLED.—About a week since, Jacob Keopart, of Bear Valley, Nevada county, was aroused by a noise during the night. According to the *Democrat*, a piece of meat had been hung to the limb of a tree, near a cabin occupied by Mr. Keopart and several others, and about the middle of the night they heard something trying to pull it down. On going to the door, they saw the grizzly standing on his hind legs eating the meat. Keopart took an ax, slipped up behind him, and struck him on the head with the edge, splitting his skull and scattering his brains on the ground. The grizzly turned and showed fight, but the others coming up, armed with axes and clubs, he was soon overpowered and killed. He weighed about five hundred pounds. Mar. 27/52

A Prolific Pair.

In the church of St. Nicholas at Ghent, there is a tablet to the memory of Oliver Minjau and Amalberga Slaugeuf, his wife, who were the parents of 31 children, 21 boys and 10 girls. Old Oliver appeared at the head of his 21 sons, all in uniform, when Charles V. made his entry into Ghent as Count of Flanders. Charles was so pleased at the fact of a simple artisan bringing up and educating such a family, that he conferred on Oliver a modest pension. The renowned Count of Abensburg, when the Emperor Henry II. visited his German provinces, presented his 32 children as the most acceptable offering he could make to his sovereign. The Count was happier with them than poor Minjau and his wife Amalberga with theirs. The 31 children of this Ghent couple were carried off together in 1626, by the *suette*, which we have no difficulty (as it is called the newly-imported disease) in recognising as the black sweat of England. Minjau and his wife died within a few weeks after the loss of all their children, among whom they lie interred. Their monument is the most affecting of the many memorials of the dead raised in populous Ghent.

An Ossified Man.—In a quiet little village on the Western Reserve in Ohio, says the Prescott *Transcript*, there lives a man who, physiologically considered, is certainly one of the wonders of the world. His joints are completely ossified—turned to bone—and he is not capable of making the slightest movement, except alternately opening and shutting two fingers of his right hand. His body is as rigid as iron, and could not be bent forward or backward without breaking some of his bones. This singular process of ossification has been going on in his system for more than twenty years. He is now about forty-six years old, and has not had the use of his limbs, so that he could walk, since he was nineteen. Ossification commenced first in his ancle joints gradually extending itself through his system until he was entirely helpless. Since that time he has been entirely under his mother's care, and she watches over him with an anxiety which none but a mother can feel. When about twenty-six years old, he became entirely blind from some unknown cause, and has remained so ever since. At about thirty he suffered greatly from the toothache, and finally he had his teeth all extracted. A year or two afterward, his finger and toe-nails all came off, and were supplied by others growing out from his fingers and toes at right angles, and presenting the appearance of horns.—What is still more singular with regard to his nails, if the end of the nail be cut off, it will bleed freely.

Such is the condition of this remarkable man at the present time. He has been visited by a great number of scientific men from all parts of the world, but all have failed to give any plausible reason of the cause of his transformation from flesh to bone. Singular as it may appear, although his jaw-bone is firmly set in his head he not only talks freely, but fluently converses with his friends and those who visit him, on all ordinary topics of the day, and he shows himself well informed and of good mind. He is always cheerful, appears contented and happy, and it seems probable that he will live many years to come. 1852

The Little Monster in your Sugar.

The sugar Acarus approaches somewhat, in organization and habits, to the louse and the itch insect itself, which are also included in the genus Acarus. The sugar mite is in size so considerable that it is plainly visible to the unaided sight. When present in sugar it may be detected by the following proceedings:

Two or three teaspoonfuls of sugar should be dissolved in a large wine glass of tepid water, and the solution allowed to remain at rest for an hour or so; at the end of that time the animalcules will be found, some on the surface of the liquid, some adhering to the sides of the glass and others to the bottom, mixed up with the dark and copious sediment. The body is oval, or rather somewhat ovate, being broader behind than before.—From its posterior part proceed four long and stiff bristles, two together on each side, and some eight or ten smaller ones are arranged nearly at equal distances around the circumference of the body; from its interior part a probosis of complex organization proceeds and from its inferior surface of eight legs, joined or furnished with spines or hairs at each articulation; the spine which issues from the last joint but one of each leg, is very long, and extends much beyond the termination of the leg itself. Lastly, each leg is armed at the extremity with a formidable hook. The Acarus Sacchari clings to life with great tenacity, for warm water does not always kill it. Hence, those who sweeten their drinks with brown sugar must swallow several of these disgusting insects in a living state, for the heat of the beverage is not sufficient to destroy them. For the consolation of our readers, we are happy to announce that this insect is never found in purified, i. e. lump sugar. It owes its existence and nutriment to the albumen, which, as we have said before, is always present in inferior sugars. It is well known that grocers are subject to an infection of the skin, denominated "grocers' itch," of which one of the symptoms is extreme irritation and itching. To this disease all grocers are not equally liable, but those particularly who are engaged in the "handling of the sugars," as the warehouseman. Now the Acarus Sacchari actually belongs to the same genus as the Acarus Scabiei, or itch insect, than which it is larger, and possessed of an organization still more formidable and forbidding.—*News of the World English paper.*

A Great Haul of Grizzlies.—Daniel Linda, says the *Pacific Sentinel*, who resides on the Cerralitos creek, about fourteen miles from Santa Cruz, and seven from Watsonville, caught, last week, four grizzly bears in one trap, inside of thirty-six hours. They were a family consisting of two old ones and two cubs. The first night the old she-bear was entrapped, and the others made their escape. The next morning Mr. Linda managed to get the old bear into a cage in which he had kept a bear last year, and placed it in or near the trap. The other three coming the second night after to look for the old one, entered the trap and were all nicely corraled. This beats anything in the bear-catching line we have seen recorded.



A HISTORY

OF THE

EARTH AND ANIMATED NATURE

BY

OLIVER GOLDSMITH

UNIVERSITY OF CALIFORNIA

from
J. H. Gurney

Alex. Taylor
Bentley
1855



WITH NUMEROUS NOTES

BY MANY OF THE MOST DISTINGUISHED
BRITISH AND FOREIGN NATURALISTS

PHILADELPHIA

Herald 19 Dec. 1857

THE MARINE WORM.—Probably much the greater proportion of our wharves are by this time quite unsound, and by no means safe places for making fast heavy ships during a gale. The immense pressure of a line of clippers against the weather side of a wharf, and the tugging, straining and plunging of those on the lee side, require some substantial support, greater than we think the majority of our wharves will offer, in their present condition. On Wednesday last, we were shown a small portion of a pile, taken from Cunningham's wharf, which was constructed in the latter part of the year 1851, or the first part of 1852, and is consequently about five years old. The sample shown us was literally perforated in all parts by the marine worm, and several of their bores resembled those made by a half-inch auger. When the worm first enters the wood, it is very diminutive, and its hole can scarcely be detected. After effecting a lodgment, it increases rapidly in size, and its destructiveness is proportionably augmented. Its progress is protected by a soft white shell, performing the duty of a sheath for its body, which is soft and tender, and protecting it from contact with the wood, except in the region of the head. This shell also serves as a perfect lining to the perforation made, and continues throughout its length. Squared piles are more rapidly destroyed than round ones on which the bark has been allowed to remain, because the bark being soft and fibrous, clogs the auger of the worm, and greatly retards its progress; and this is wanting in square piles. For the same reason, these worms prefer moderately hard wood to that which is soft. Eastern vessels engaged in the lumber trade with the West Indies, instead of being coppered, are generally "sheathed" with thin boards, not over half an inch in thickness, laid over a sort of prepared paper. The worms in the Caribbean sea quickly perforate this sheathing, which rarely lasts over two years, but their further progress is effectually barred by the paper, which their augers cannot penetrate on account of being clogged. The bottom of the vessel is thus preserved from their attacks, and at the same time she is rendered somewhat more buoyant by the addition of her sheathing, which necessarily enlarges her bottom surface. Should we be visited this winter by any very heavy gale, it is altogether probable that considerable damage may ensue from the rotten and worm-eaten condition of our wharves, most of which have been constructed long enough to, by this time, have become effectually perforated by the worm, which abounds in our waters.

The Greatest Curiosity of the Age.

Without question the greatest natural living curiosity in the United States, is now on exhibition in Charleston, S. C. The *Mercury* describes it as a living negro child, with two heads, four arms and four legs. It is six years old, very intelligent, speaks with both mouths, sings well, waltzes and keeps time. This much the bill says, but the beholder cannot dismiss from his mind that he has before him two children, though strictly speaking there is but one. The connection is with the spine, and the best physiologists of Europe and this country have pronounced it one individual child.

N. Y. Herald.

THE TRUTH OF THE FLORAL LEG STORY.—Sometime ago the *Bulletin* republished from an Eastern paper, an extraordinary story of a natural flower growing out of a boy's leg. It appears that Samuel J. Parker, of Ithaca Tompkins county, N. Y., did not feel particularly pleased with the Atlantic papers circulating the curious floral tale, and, on the 19th November last, addressed to the N. Y. *Tribune* a note on the subject, in which he says:

I notice in your paper, an article quoted from an "exchange paper," making some disparaging remarks on the singular growth out of a leg of a child in this place. It is time that, when this article is running the rounds of the press, the truth should be known. It is unjust to Prof. Hawley, (late of the medical college of Geneva,) and the medical profession in this part of the country, to represent that either the Professor or we, any of us, are very silly as to believe that any actual vegetable grew out of the leg of this boy. The press does us great injustice to speak of "orange flowers," or "aster flowers," as a reality. I may say that the diseased leg is like a carrot or turnip in shape, and if any one should say that I said disease made a man's leg a carrot or turnip, he would misrepresent my language grossly.

The facts are, that out of a preternaturally large leg grew a fungoid stem; and when partly grown the end of its bore a slight resemblance to a single orange bud just about to open. When at full growth it had some slight resemblance to a China-aster flower or dahlia when open. But the growth was animal blood circulated in the abnormal growth. This animal growth is now preserved in alcohol, and will be submitted to several medical societies. It is like, to use my language, sea-weed. A stem a few inches long; where it expands like a mushroom, or end of a sea-weed, is a smooth circular space. Then outside of this circular space ran fibres like sea-weed, with the minute blood vessels giving cale through the thin animal tissue.

Now call it what you please, sea-weed, mushroom, China-aster, orange bud, it is a rare form of a very common disease, "the bloody fungus," known for centuries to the medical world. I believe it a rare species, however, and well worth figuring and describing in our medical journals. Please disabuse the public of the contemptible rumor, and let a matter of fact stand as it is, a rare form of animal malignant growth.

1857

Our Carson Valley Correspondence.

GENOA, CARSON VALLEY, Jan. 5th, 1858.

EDITOR OF THE SAN FRANCISCO HERALD:—Although it is quite cold enough for me here now, I am informed by some of the oldest inhabitants that the winter is remarkably mild; we have had three slight falls of snow, all of which disappeared in a day or two—the mornings are frosty, but towards noon it gets very pleasant. No rain having fallen, the miners at Gold Canon are doing nothing. A party of men from this place started today to explore the head of Carson river, expecting to find rich diggings. I am myself going for a day or two into this region, and will in my next give you an account of my explorations. Among the most remarkable natural curiosities I have seen in this country is a petrified egg, which I found about the middle of the Valley—it is about the size of a goose egg, of a bluish color, and as hard as a rock. I will send it to you by the first opportunity.

Christmas passed off quite merrily here, no disturbance taking place, as is usual on such occasions—at the Canon, however, a jealous husband was shot in the leg by the gay Lothario, whom he imagined had done him injury. The Washoes remaining quiet. Uncle Billy's "army of occupation," as you were pleased to call it, on your side of the Sierra Nevada, has been disbanded; the men took their discharge in writing, and left on foot for California—one of them, however, returned with frozen feet.

TENNESSEE.

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VOLUME II.

BLACKIE AND SON, QUEEN STREET, GLASGOW;
SOUTH COLLEGE STREET, EDINBURGH;
AND WARWICK SQUARE, LONDON.

An Unparralleled Phenomenon.

Dr. J. E. Hawler, of Ithica, N. Y., formerly Professor of Surgery in the Geneva (N. Y.) Medical College, publishes a statement in the (Ithica) *American Citizen*, which will equally astonish the world at large and the medical profession, for, we presume, a like case was never known in the world. It will puzzle the skill of the wisest of them to account for this strange phenomenon. We give Dr. Hawler's whole statement of the case, in his own words, and leave others to judge of the remarkable occurrence:

"The subject of this remarkable phenomenon is between thirteen and fourteen years of age. His name is Oliver Elsworth Northrop. I have known him from his birth to the present period. His mother died when he was a few months old, of *Tubercular phthisis puluonodis*, (or consumption,) and his father followed her within a twelvemonth after, with the same disease. He was a feeble infant, and in about two months after he was born, a great tenderness was perceived about his right hip joint. At two years, there was considerable tumefaction over the joint; this was alternately relieved and it reappeared, until, at about five years old, an abcess formed on the same side between the spine and the hip, this was opened and continued to discharge for six months. In his eighth year, an abcess was formed at the point of the first tumefaction, subsequently a number of abcesses have formed on the same side. The hip joint has been dislocated by the intense action of strumous disease; the limb is drawn towards the body with a perfect anchylosis of the hip and knee joints. The left fore-arm is drawn up to the shoulder, and the elbow joint is completely anchylosed; the condyles are as distinct as if they were not covered by skin; and, indeed, all the parts of the body that are not affected by the tumefaction are in a similar condition, so that one might almost study [illegible] his person.

This is but a faint description of this very remarkable case. Yesterday morning as I was coming out of the Drug Store of B. S. Halsey, I was hailed by P. I. Partenheiner, Esq., with a request to call at Mrs. Munger's, where the lad resided with his grandmother, Mrs. Ellen Curtis. I immediately repaired there, and on entering the sick room, Mrs. Curtis threw off the sheet that covered the right limb, which had been for a long time immensely swollen; there was presented to my view a stem, on the inner side, at the edge of the Gastrocnemius muscle, rising at right angles with it more than seven inches in height, with a flower squarely set upon it, to my own apprehension resembling the Passion Flower, but which Mrs. Munger thought resembled the China Aster. Mrs. Munger stated, that on Wednesday, Ellsworth said that he felt an oozing from what had been expected to be an abcess, and expressed great relief. He did not permit any examination until Saturday afternoon, when she and Mrs. Curtis beheld a stem arising at right angles with the limb, at about the height of three inches, crowned with three white buds, in the language of Mrs. Munger, resembling the '*white buds of the Orange*,' on being exposed to the light, the flower had expanded, and assumed the color of a beautiful greyish purple.

The phenomenon was so strange, that I could scarcely trust my own senses, and immediately called upon my friend and esteemed counsellor, Dr. John Stevens, and Dr. J. O. M. Ingersoll, formerly a highly respected member of the faculty, but now devoting himself with much reputation to dental surgery, together with the Rev. W. S. Walker, of the Episcopal Church, whose acquirements in literature and as a minister of the Gospel, are well known; they saw the case and can abundantly testify to the truth of the above statement."

Death of a Distinguished Native Californian.

Ben Franklin, the grizzly bear, the favorite of the Museum man Adams, the companion for the last three or four years of his various expeditions in the mountains and his sojourns in the cities and towns of California, departed from this mortal existence on Sunday evening, at 10 o'clock. The noble brute, which was captured at the head waters of the Merced river in 1854, had been raised by his master from a cub, and during his life manifested the most indubitable indications of remarkable sagacity and affection. He was ever tame and gentle, and although possessed of the size and strength of a giant among brutes, was in disposition peaceful; rough, it is true, in his playfulness, but always well-disposed. He accompanied his master on hunting expeditions to the Rocky Mountains and through various portions of California, and on two occasions saved his life in long and desperate struggles with savage animals in the wilds. He frequently carried his master's pack, provisions and weapons; frequently shared his blanket and fed from the same loaf.

During the last two years Ben was the "star" animal in Adams' wonderful collection in this city, and has spent his time in exhibiting his frame, rearing upon his colossal legs and shaking his immense chains, for the amusement and edification of spectators and the profit of his master. Many of our readers have often seen him tramping at the length of his chain in the midst of the other animals of the Pacific Museum. One of his eyes was observed to be injured and several scars were to be seen about his head and neck; but they were honorable wounds and reflected as much credit upon poor Ben as the scars of a brave soldier. They were all received in the service of his human friend, protector and master. As might be supposed, his loss has been severely felt by Adams. The old hunter would willingly have lost all the balance of his collection to have saved Ben. We recollect that such were Adams' feelings towards Ben, when the Museum was first established in the city, and during frequent visits to observe, over and over again, and study the habits and characters of his wonderful animals, we never once heard Adams express any other but sentiments of preference for this faithful creature. 1857 Dec.

Ben's sickness was some internal disorder, which could not well be understood, and for which no remedy was known. Had any cure been possible, no cost would have been spared to procure it. After an indisposition, however, of about a week's duration, during which time the animal refused to eat or drink, he sank on Sunday evening under his malady and died without a struggle. His shaggy skin was cut off yesterday, and all that can be kept of him, his form and outward appearance, will be preserved. His sagacious expression, however, and his great affectionate spirit are gone forever. Alas, poor brute!

Capt. S. Rutchinson,

CRATER MOUNTAIN.—A correspondent of the *Yreka Union* thus describes Crater Mountain, in Siskiyou county: Near the summit the trees become somewhat sparse, and of a stunted growth, and dreary-looking ridges lowered above us. One of these seemed to have been harrowed up in a solid into angular blocks, fitting beautifully together. Half a mile above this, greatly to the relief of our tired feet, we reached the sand, the outer rim of the basin which crowns the summit. Dead trees, chiefly pines, blown out of root, dry and hard, were strewn about in every direction, and young pines were again growing in their stead. These dead trees, some of them pretty large, give us a record of many departed ages. Meeting on the eastern summit, which is the top of the mountain, we had a fine view of this sand pan of nature. Its mouth cants towards the West, is about one mile in circumference, and, as we afterwards found, upon careful inspection, is about three hundred feet deep on the east side, one hundred feet on the west, sloping gradually down all around to the bottom of the basin; while on the summit we became sleepy, the same as one does on Shasta Butte; but the grandeur of the scene was too exciting to yield to slumbers.

SHOWER OF WORMS.—During a recent shower in San Francisco, an immense quantity of red earth worms fell in the vicinity of Union, Greenwich, Powell and Green streets. The roofs and streets were alive with them. Jan 18 58

VALUE OF CALIFORNIA WILD BEASTS.—A menagerie, called "The Mountain Museum," for some time back exhibiting at J street, Sacramento, was sold out by the Sheriff on the 20th January. The *State Journal* gives the following schedule of prices, in order that the curious may see what value is put upon live animals and other curious things which go to make a *show*:

2 sea lions and cage	$40 00	1 stuffed fox and case	$ 2 50
1 sea leopard	5 00	1 stuffed two-legged pig	1 00
1 black bear	12 00	1 stuffed seal	3 00
1 wild grizzly	15 50	1 bird cage	75
1 tame grizzly	20 50	1 double-headed calf	5 25
1 tame grizzly	19 00	1 bird of Paradise, and other feathery specim's.	17 50
1 cinnamon bear	20 50	1 case birds	10 50
1 small black bear	10 50	Stuffed fox, bear and panthers	3 00
1 small black bear	20 50	Lot of stuffed birds	2 25
1 cage, containing badger, wild cat and coyote	5 00	Sundry fixtures, etc	26 25
1 case of butterflies, etc	12 50		
1 case of stuffed birds, etc.	10 50		
Total			$263 50

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Letter from Melbourne.

Austtralian News. 1857

[FROM OUR OWN CORRESPONDENT.]

MELBOURNE, 31st October, 185[illegible]

The Flour Market at Melbourne—Prospects of the Harvest in Australia.

Exploration of the Interior of Australia—Character of the Discovered Country.

Australia is not only a political phenomenon, but a scientific one. M. Blandowski and a party of Germans have been making some explorations in the interior of this anomalous region, and have published a very interesting account of their investigations. The party did not proceed further than eight hundred miles in the interior. Referring to the geological peculiarities of the country, he describes an unusual stratification of pale yellow sandstone, succeeded by brown-colored ferruginous sandstone, which is again followed by a dirty-yellow limestone-like sandstone. He found large numbers of beautiful fossils, the hard outside of which had resisted the action of the atmosphere and water to a surprising degree, displaying the most elegant forms in a state of perfect preservation. As to the general aspect of the country, he confirms in every respect the statements of the natives made some years since, and generally esteemed fabulous, viz: "That the sharply pointed stones and great rocks would fall down upon and crush visitors; and that, even if they escaped from this danger, they would be killed by the heat. That neither grass, water nor wood are to be met with; that the wells are very deep, and the cattle unable to drink therefrom; that the water is salt, and that the natives drop down bundles of rushes to soak it up;" etc. etc.

Discoveries in the Animal and Vegetable Kingdoms—The Aborigines.

Blandowski next proceeds to describe the animal and other productions of this remarkable region. In the rivers he found sweet water sponges in great quantities—a circumstance he believes to be quite new to the scientific world. He also describes the discovery of a great variety of spiders, a beautiful species of sperical lobster, two varieties of cray fish, and three kinds of new shrimps, also eight different species of the muscle, hitherto unknown, six bivalves belonging to the family *Unis*, seven univalves to *Lymnea Succinea* and *Physa*, of which three prove viviparous. He also describes twenty distinct forms of fish and five new frogs. He has also gathered twenty-four distinct species of snake, of which sixteen are *entirely new*. Among these, the most remarkable is a reptile exactly cognate to the boa of South America, with the exception that it is much smaller. This Australian boa is harmless, it climbs trees and waits for its prey in the top-most branches of the gum tree, from which it pounces upon, and crushes and devours its prey. Of lizards he has added eleven remarkable forms to the six already known. He has also discovered three varieties of turtle.

With respect to birds, M. Blandowski has added two new forms, viz: the brown capped *pomatorkinas*, the rufus-tailed cuckoo, and the brown coated *dunihiza*. Further north he found the bee-eater and red-tailed parrot, also the *eos* or rose-bellied cockatoo, and crested pigeon; still further north he met with the ground dove, the porphyry-crowned parroquet, and a peculiar kind of grass parrot. Altogether, he discovered eleven distinct kinds of distribution of birds. He was informed by the natives that further in the interior the red-breasted cockatoo was to be seen.

Of quadrupeds, he has met with twenty-six well marked species, of which eleven are *not* marsupial, and five are entirely new in the creation. Among his new species, he mentions a small animal called by the natives the *yako*, which digs up and devours the dead bodies of the natives.

He next touches on the aborigines, whom he describes as an athletic race, some of whom were of gigantic proportions. They live principally on *typha* or *calamitex* roots, which they bake. Sham fights are their principal amusements, and the various tribes frequently engage in actual war. The graves are huts covered with the manur nets of the dead, in which the currinetes have to sleep at nights. The female relatives enter the tombs every morning before daybreak to give expression to their grief. Among some tribes they make a funeral pile in front of the grave and cry bitterly. On leaving, the widow plants a green bough on the grave. In other tribes they burn the body after death on a scaffold. These customs bear a strong resemblance to those of India, and of some of the nations of antiquity. M. Blandowski is now in Melbourne and informs me that it is his intention to prosecute his researches into the heart of the interior.

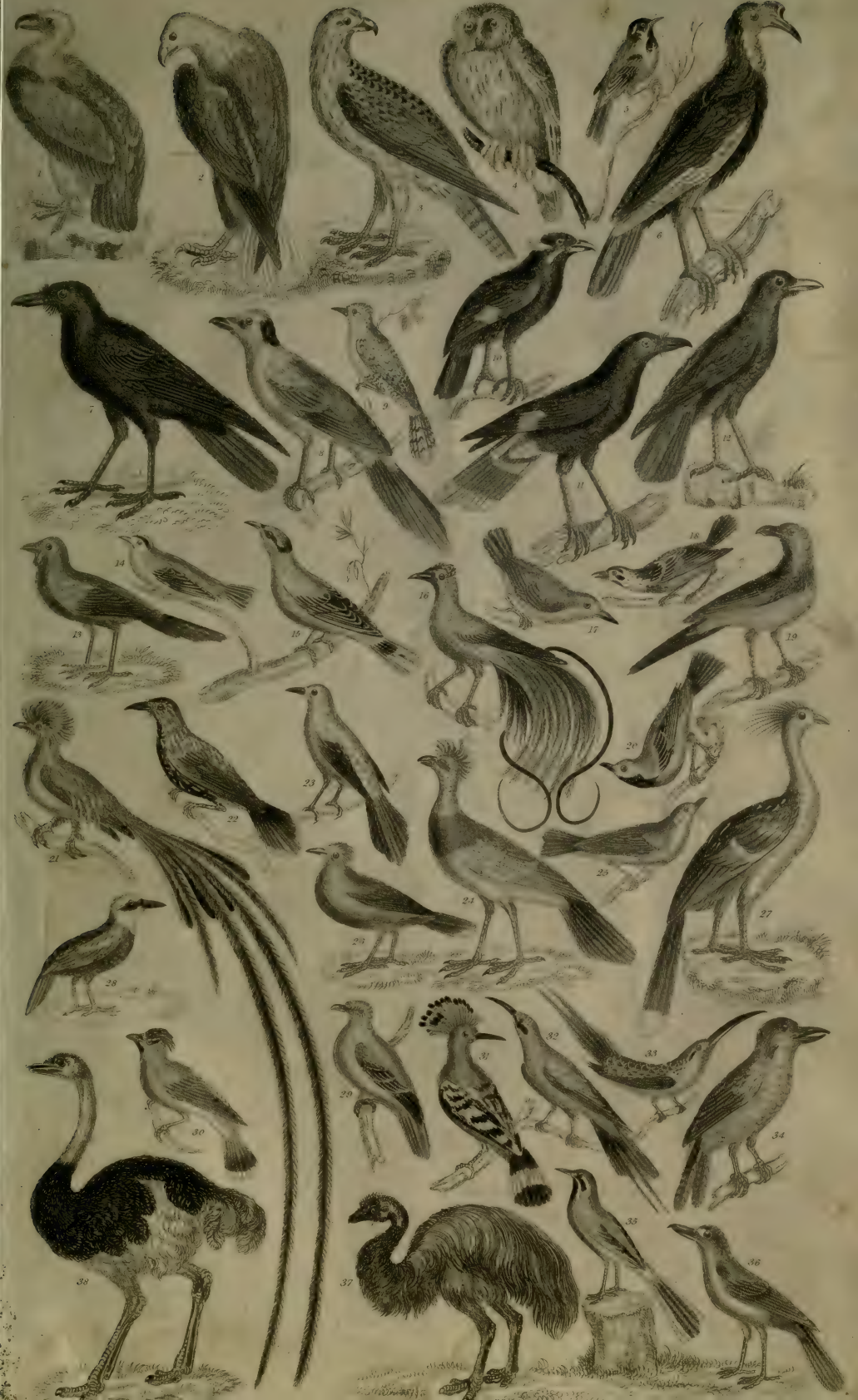
Artesian Wells—A Chance for California Borers.

There is something of a mania prevalent for boring Artesian wells in the colony, which I think would afford a chance for California speculators in this line.

SIZEABLE EGG.—We were shown, yesterday, an egg, the circumferences of which measured, respectively, 7¾ and 5½ inches. It was the product of a small common barnyard fowl, that has never cackled anywhere but in this city.—*Sacramento Union.*

That's a pretty good size; but, as strange as the coincidence may seem, we were yesterday shown two eggs, produced on the ranch of Mr. Meeker, on the Mokelumne river, in this county, each measuring in circumference, respectively, 7½ and 6 inches. The two eggs weighed, collectively, 5½ ounces. They were the product of two hens, of the mixture of Shanghae and Poland breeds.—*San Joaquin Democrat, March 31st.*

RUNNING DOWN WILD HORSES.—The Mexicans sometimes reserve an old steed in native wildness, for the purpose of tiring down a band of mustangs. They stuff a suit of cloths with rules, and then tie it in an erect position on his back, and when a band of mustangs is discovered he is turned loose. The stud with straining flight, seeks the band; they see him coming, apparently with a rider on his back, and away they go, he after them—wondering why they fly away so rapidly from his presence. His native signals are all useless, they heed them not—they see the figure on his back—anxious fears lends swiftness to their speed; straining his sinews for a determined effort, he rushes after them with the pace sf the wind, urged on by all the fury of revenge. The Mexicans are keenly watching the race, and when they think the band is nearly used up by running away from imaginary danger, they rush in on fresh horses, and t[illegible] the sweeping lareat descends over the h[illegible] of the tired mustangs.—*Mariposa [illegible]ocrat.*


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THE SNAKE THAT SWALLOWED THE HORSE.—In the province of Gozar, Dr. Gardner came to the fazendo of Sape, situated at the foot of the Serra de Santa Brida, near the entrance to a small valley. Dr. Gardner remarked, that in this valley, and throughout this province, the anaconda attains an enormous size, sometimes reaching forty feet in length; the largest which he saw measured thirty-seven feet, but was not alive. It had been taken under the following circumstances: Some weeks before our arrival at Sape, writes Dr. Gardner, the favorite riding horse of Senhor Logœira, which had been put out to pasture not far from the house, could not be found, although strict search had been made for it all over the fazenda. Shortly after this, one of his vaqueiros (herdsmen), in going through the wood by the side of a small stream, saw an enormous sucuruju suspended in the fork of a tree which hung over the water. It was dead, but had evidently been floated down alive by a recent flood, and being in an inert state, it had not been able to extricate itself from the fork before the waters fell. It was dragged out to the open country by two horses, and was found to measure thirty-seven feet in length. On opening it, the bones of a horse in a somewhat broken condition, and the flesh in a half digested state, were found with it; the bones of the head were uninjured. From these circumstances, we concluded that the boa had swallowed the horse entire. In all kinds of snakes, the capacity for swallowing is prodigious. I have often seen one not thicker than my thumb swallow a frog as large as my fist; and I once killed a rattlesnake four feet long, and of no great thickness, which had swallowed no less than three large frogs. I have also seen a very slender snake that frequents the roofs of houses, swallow an entire bat three times its own thickness. If such be the case with these smaller kinds, it is not to be wondered at that one thirty-seven feet long should be able to swallow a horse, particularly when it is known that previously to doing so, it breaks the bones of the animal by coiling itself around it, and afterwards lubricates it with a slimy matter, which it has the power of secreting in its mouth.—*Brazil and the Brazilians.*

WHAT ONE MAN HAS DONE.—Zadock

WALLED LAKE IN IOWA.—A correspondent of *The Cincinnati Gazette* gives an account of a walled lake in Wright County, Iowa. He says:

"To me it was one of the greatest curiosities I had ever seen—enveloped as its history is with a mantle that will probably never be withdrawn. This lake lies in the midst of a vast plain—the rich, gently undulating prairie extending for many miles in every direction. The lake covers an area of about 1,900 acres. The water is clear and cold, with a hard, sandy bottom, from two to twenty-five feet deep. There is a strip of timber about half way round it, probably ten rods wide, being the only timber in many miles. *There is a wall of heavy stone all round it.*

"It is no accidental matter. It has been built with human hands. In some places the land is higher than the lake, in which case the wall only amounts to something like a *rip-rap* protection. This, I believe, is what engineers call it. But in other places the water is higher in the lake than the prairie outside of the wall. The wall in some places is ten feet high; it is thirteen feet wide at the base, sloping up both sides to five feet wide on the top. The wall is built entirely of boulders, from three tuns in size down to fifty pounds. They are all what are called *lost rock*. I am no geologist, and consequently can give no learned description of them. They are not, however, natives, 'to the manor born.' Nor has the wall been made by the washing away of the earth, and leaving the rocks. There is no native rock in this region. Besides, this is a continuous wall, two miles of which, at least, is higher than the land. The top of the wall is level, while the land is undulating—so the wall is in some places two feet, and in others ten feet high. These rocks, many of them at least, must have been brought a long distance—probably five or ten miles. In Wright County the best rocks are scattered pretty freely, but as you approach this lake they disappear, showing that they have been gathered by some agency—when or by whom history will never unfold. Some of the largest oaks in the grove are growing up through the wall, pushing the rocks in, in some cases, outside in others, accommodating their shape to the rocks. The lake abounds with excellent fish. The land in that township yet belongs to the Government.

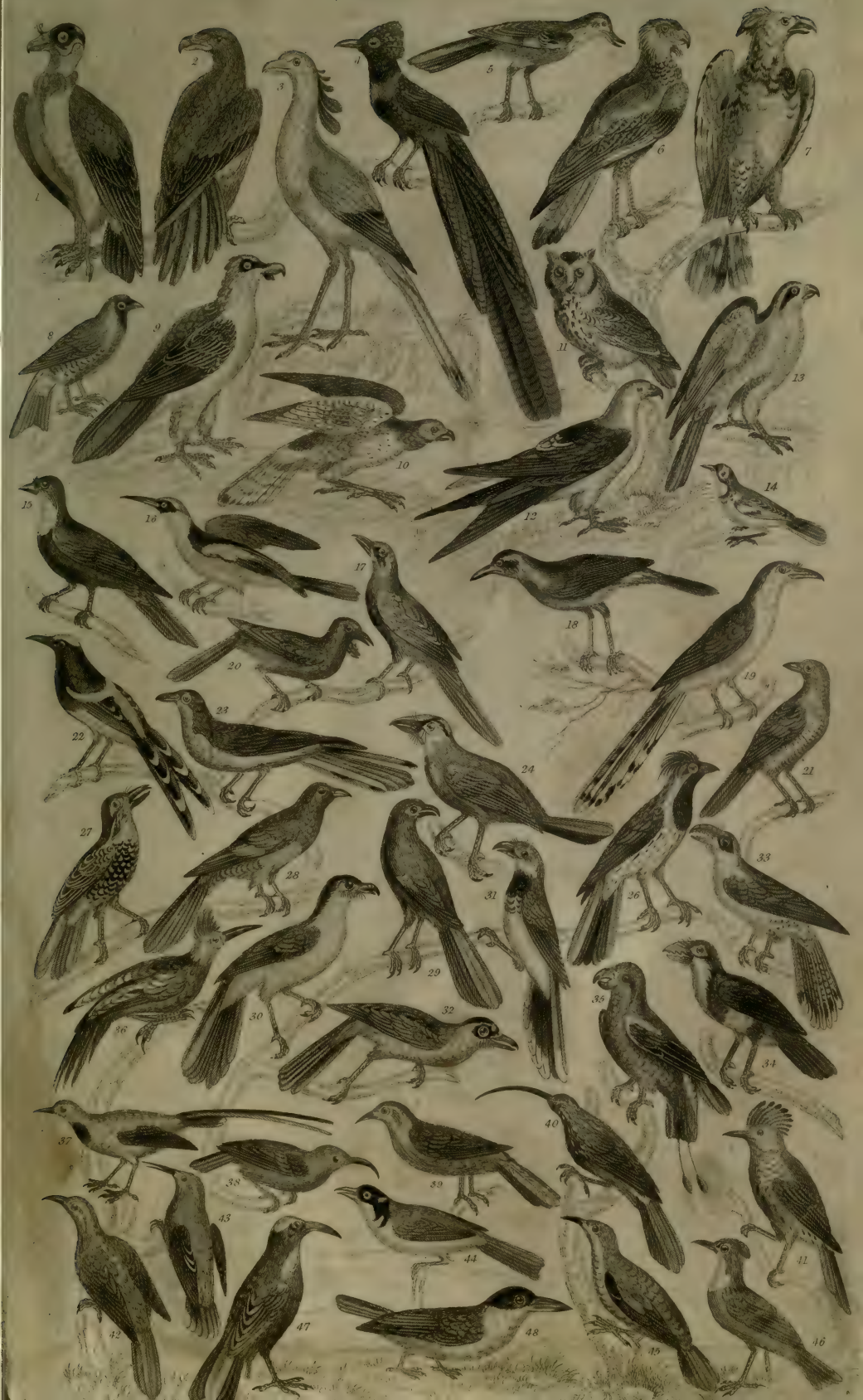
IOWA.—The following comparison of the taxable property of Iowa for the last seven years is given as an indication of the progress she is making in wealth:

In 1851 it was.....	$28,464,550	In 1855 it was.....	$106,895,390
In 1852 it was.....	38,427,376	In 1856 it was.....	164,394,413
In 1853 it was.....	49,540,304	In 1857 it was.....	240,044,533
In 1854 it was.....	72,327,204		

writes: Perhaps some of the *Bulletin* readers know that there is a woman now living in Chester, Warren county, in New York State, who has not tasted food for twenty months. Her name is Betsey Hayes; she was born in New York, is married, is twenty-seven years old, and is the subject of no hereditary disease. Her husband states that she always enjoyed good health until three years ago, when she was seized with a sort of convulsive fit. These convulsions continued to increase in severity until the 4th June, 1856, when she fell into a state of complete unconsciousness, from which she has never been aroused. Since that time she has partaken of nothing except a little lemonade in February, 1857, and since then nothing—not excepting water. To all this the husband has made oath; and gentlemen, whose veracity cannot be questioned, have watched the woman for weeks, and testify to the same facts. The patient was recently visited by an intelligent medical man who has made some interesting observations on her condition. Among others he says: All the senses, except smelling, seem to be obliterated, while this is morbidly acute, so much so that the smell of food of all kinds, perfumery, and in fact anything having an odor, will induce the most violent convulsions.

The pupil of the eye presents the appearance usually found in amaurosis. On percussion of the chest, a resonance clearer than in health is observed over all parts. By oscultation, no respiration or expiratory murmur is heard upon the closest examination. The minute air cells seemed to be filled with air so completely as to allow none to enter. The average number of respirations are once in eight minutes; and when she does respire, it is with a convulsive motion similar to one trying to catch breath. The heart occupies its normal position, and is of natural size. It acts violently but feebly, and is intermittent, varying from 80 to 180 beats per minute. The pulse can be but seldom felt at the wrist. The color, heat and moisture of the patient's body are all natural, and there is little or no emaciation apparent. Such are some of the abnormal conditions of this wonderful woman. A minute report of her disease, and its symptoms, is in course of preparation for the faculty.

[We notice in some of the Eastern papers an item stating that this woman had died, and on making a *post mortem* examination of her body, a living snake, several feet in length, was discovered in her stomach. If it had been a *live "canard"* we should not be half so incredulous as we confess ourselves now.—ED.


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WHAT I SAW IN INDIA.

The Mungoos and Cobra.

A short time anterior to the recent mutiny in India, I commanded a little detachment of native infantry at Condapilly in the Northern Circars. From once having been a town of considerable importance, it has dwindled to a very inferior rank; and the hill-fort, at one period of considerable strength, now presents nothing but

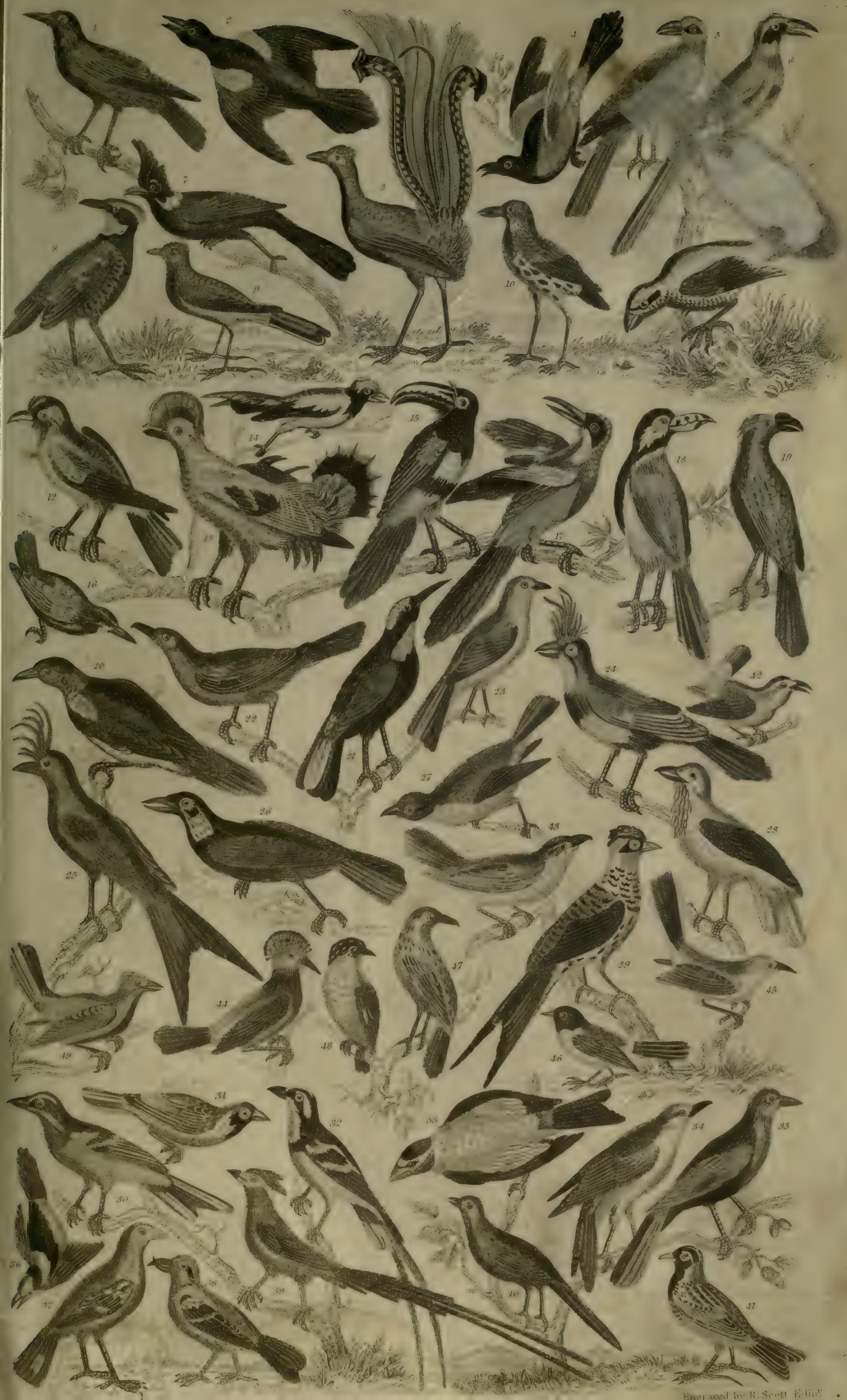
[illegible] esplan[illegible]

[illegible] with the [illegible]arted in [illegible]ound, from [illegible]distant. We [illegible]native horsemen, [illegible]ving a swift mare, [illegible]d at a rapid pace. When [illegible]m the bungalow, we overtook a large [illegible] monkeys. I should say there were as many as four hundred; and each carried a stick of uniform length and shape. They moved along in ranks or companies, just as though they were imitating a wing of a regiment of infantry. At the head of this tribe was an old and very powerful monkey, who was no doubt the chief. It was a very odd sight, and I became greatly interested in the movements of the creatures. There could be no question that they had either some business or some pleasure on hand; and the face of each carrying a stick led us to conclude that it was the former upon which they were bent. Their destination was, like ours, evidently Deobund, where there are some hundreds of monkeys fed by a number of Brahmins, who live near a Hindoo temple, and perform religious ceremonies. They (the monkeys) would not get out of the road on our account, nor disturb themselves in any way; and my friend was afraid to drive through their ranks, or over any of them; for, when assailed, they are most ferocious brutes, and armed as they were, and in such numbers, they could have annihilated us with the greatest ease.—There was no help for us, therefore, but to let the mare proceed at a walk in the rear of the tribe, the members of which, now that we were nearing Deobund, began to chatter frightfully. Just before we came to the bungalow, they left the road and took the direction of the temple. Fain would we have followed them, but to do so in the buggy would have been impossible, for [illegible]ome very rough ground and [illegible]end therefore requested [illegible]d report all the[illegible] Meanwhile w[illegible] [illegible]rriving at wh[illegible] very old [illegible] [illegible]ight w[illegible]

[illegible] gone [illegible] cleanly a[illegible] remove a ch[illegible] are a very o[illegible] has; wonde[illegible] selves; li[illegible] capable [illegible] obedient [illegible] fawnin[illegible] man. [illegible] their [illegible] tide [illegible] ban[illegible] de[illegible] k[illegible], and sla[illegible] [illegible]posed) galla[illegible] [illegible] to say [illegible] a frequent [illegible] though it do[illegible]pen now and then. [illegible] the Goorkha women are as virtuous [illegible] able as their husbands are honest and b[illegible]

At a surprise party, February 2nd, [illegible] following toast was given:—"Here's to the [illegible] who swears, steals and lies—swears off from d[illegible] ing, steals away from bad company, and lies [illegible] honest bed."

Quoth Smith to Jones, it really is a sin
You do not get your pretty house fenced
Quoth Jones, you're wrong; the place is f[illegible]
confound it,
My wife is all the time a *railing* round it.



Engraved by R. Scott Edin.r

A Visit to the German Philosopher Humboldt.

Bayard Taylor, having finished his travels in the northern countries of Europe, revisited Germany. Writing from Gotha, on 24th October last, to the N. Y. *Tribune*, he describes a visit which he had just previously paid to the cel[illegible] man of science and philosopher Humbold[illegible] hen residing in the palace of the King [illegible]lam. This was when Alexander H[illegible] ing a visit to the Prussian mo[illegible] the eighty-ninth year [illegible]

I was [illegible]ary, on the threshold of [illegible]en, [this was about noon,] [illegible]tly paler than before, a little [illegible] could see that his step was not [illegible] blue eye beamed as clear as an intelligence ever, and the voice had as steady and cheery a tone. He shook hands with the cordiality of a friend, and, after the first greetings were over, questioned me minutely concerning my travels in the North.

But one topic soon suggested a hundred others, and he was ere long roaming at large over the whole field of geography and climatology, touching the farthest and darkest regions of the earth with the light of his stupendous knowledge. The sheets of the new volume of *Cosmos* lay upon the table.

"Here is what I have been doing, since you were here before," said he, taking it up: "the work will be published in two or three weeks."

"You find yourself, then, still capable of such labor?" I ventured to ask.

"Work is now a part of my life," said he; "I sleep so little, and much rest would be irksome. Day before yesterday, I worked for sixteen hours, reviewing these sheets."

"Are you not greatly fatigued," I asked, "after such an exertion?"

"On the contrary," he replied, "I feel refreshed, but the performance of it depends greatly on my state of bodily health. I am unconscious of any mental fatigue."

As I saw in the face, and heard in the voice, of the splendid old man, all the signs of a sound, unfailing intellect, I could well believe it. I had prided myself a little on having worked with the brain fifteen hours a day for six months, yet here was Humboldt in his eighty-ninth year, capable of an equal exertion.

The manner in which he spoke of his bodily health was exceedingly interesting to me. His mind, full of vigor and overflowing with active life, seemed to consider the body as something independent of itself, and to watch, with a curious eye, its gradual decay, as he might have watched that of a tree in his younger days. "I have been unwell through the summer," said he, "but you must not believe all you may have seen in the newspapers concerning my illness. They stated that I was attacked with apoplexy, but it was only a vertigo, which soon left me, and has not been followed by any of the usual effects of apoplexy. One result, however, shows that my body is beginning to give way. I have not the same power of controlling my limbs as formerly: the will does not seem to act upon the muscles; [illegible] dinner given to Alexander [illegible], which is probably a

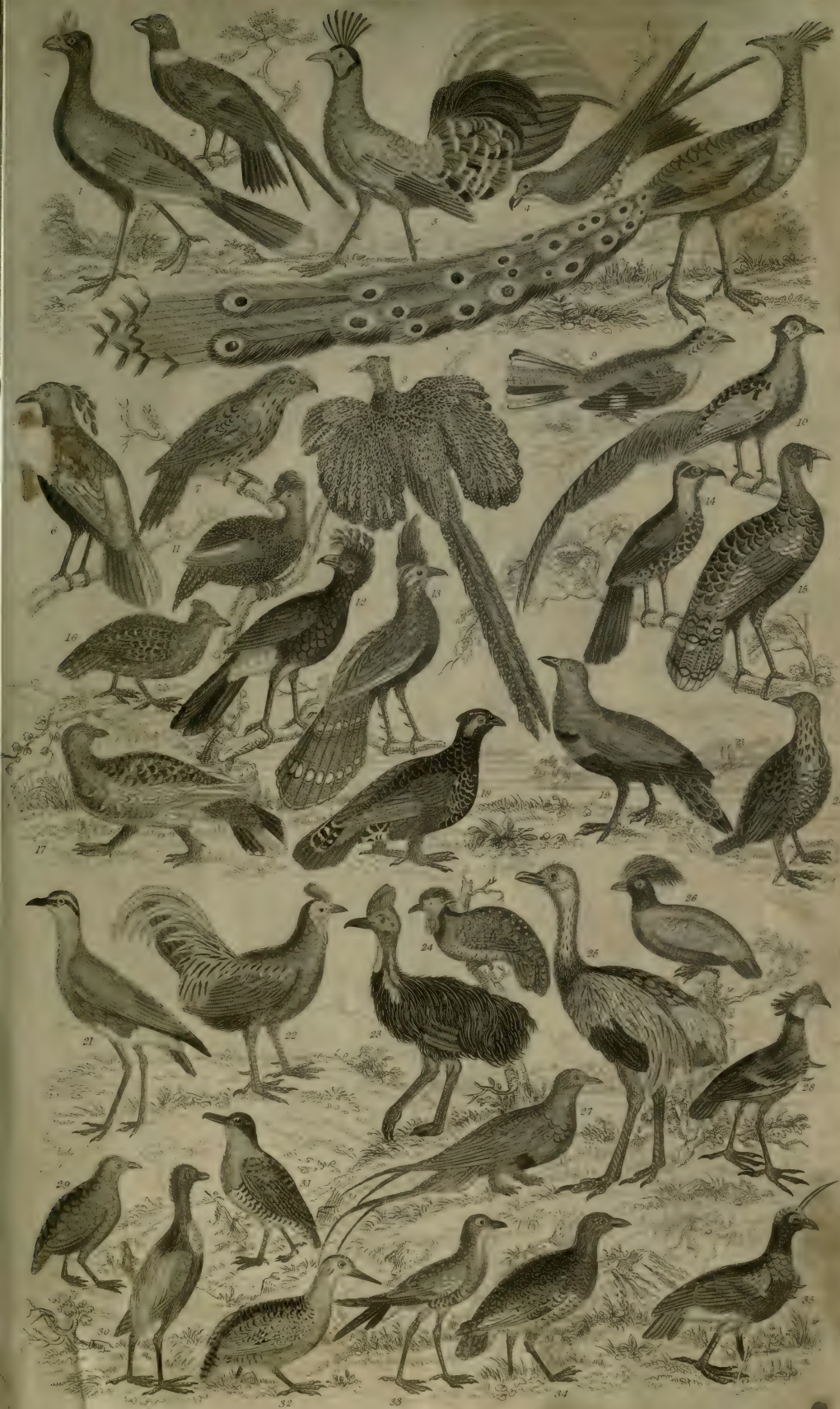
"You will pass through Berlin on your way to Moscow?" said he.

"Yes."

"Well—I must be polite enough to live until then. You must bring your wife with you. Oh, I know all about it; and you must not think, because I have never been married myself, that I do not congratulate you."

After these cordial words, and a clasp of the hand, in which there was nothing weak or tremulous, I parted from the immortal old man.

I was glad to learn from Seifert, [Humboldt's body-servant], that Hildebrand's admirable water-color drawing of Humboldt in his library, is soon to be printed in chromotint, so that very accurate copies of it can be obtained at a moderate price. As I have not only seen the original, but the room and man it represents, I can testify to its entire fidelity, and would suggest to Humboldt's admirers in America that they cannot procure a better illustration of him. I suppose copies of it will be sent to America for sale. Herr Möllhausen, Seifert's son-in-law, who is now attached, as artist, to the expedition for the survey of a wagon-road to the Pacific, prepared for the press, before leaving Berlin, a splendidly illustrated work on the Gila country, which is now being published under the patronage of the King. It will cost about $28 a copy. Humboldt himself wrote the preface, a copy of which he gave me. He was greatly gratified at the readiness with which our present Secretary of War gave Mr. Möllhausen a second appointment.



Drawn by Capt.n Brown. Engraved by R. Scott F.R.S.

THE HONEY BEE IN CALIFORNIA. — F. G. Appleton, of San Jose, has furnished the *Alta* with some interesting particulars connected with the introduction of the honey bee in this State and the adaptation of our climate and products to their success:

The amount of honey and beeswax produced in the United States, as returned by the Census Agents, for the year 1850, was 14,662,500 pounds, which estimated at fifteen cents per pound, gives the sum of $2,199,375, as the value of this production for that year.

One Shelton (in connection with Commodore Stockton and G. W. Aspinwall) imported, in March, 1853, the first bees into California. He left New York with twelve stands or hives, and arrived with but one; from this one there are now about one hundred and fifty swarms.

Buck, Appleton, Early, Daniels, Lathrop, and Gates, of San Jose; T. G. Baxter, of Napa; Capt. Hoag and Harbison, of Sacramento, and Neyman, of Mokelumne Hill, are each interested in the business to the extent of 10 to 100 swarms; many others have from one to ten.

About 3,000 pounds of honey was produced last year; it being more profitable to increase swarms at present, but little attention has been given to induce bees to store surplus honey; the object has been to force bees to throw off swarms. From some of my swarms I have taken from each sixty pounds of pure honey in top boxes. In each colony there are in the swarming season three kinds of bees—a queen, considerable number of drones, and thousands of workers. The queen is the only fully developed female; the drones are males, and the workers are undeveloped females. The honey bee is not a native of California; those swarmed here do not differ from the original imported; both thrive equally well. Some bees have been brought hither from Mexico, but they are the same in all respects as our bee. The Italian honey bee has not been imported into the United States. Aristotle, who flourished 2,200 years ago, speaks of three different kinds of honey bees, as well known in his time. Virgil, in his fourth book of Georgics, speaks of two kinds as flourishing in his time. The better variety he characterizes as spotted or variegated, and of a beautiful golden color. Strange to say, within a few years, the attention of bee keepers has been called to the very variety described by Aristotle and Virgil, and after a lapse of 2,200 years, it is still found to exist, distinct and pure from the common kind, and to be as superior to it as a Durham ox to one of the poorest breeds.

The California honey, made from mustard blossom, the flower from which most of the honey is gathered in this valley, is equal to any I have ever tasted. It has sold in San Francisco at from $1 25 to $1 50 per pound. New swarms issue as early as the 15th of April, and the swarming season continues to 16th of June. The swarms usually cluster upon a branch of a tree or bush. The operator should have his hive ready; take a blanket, or sheet, and spread it upon the ground, under the cluster, place the hive upon it, raised an inch to permit the bees to enter freely; give the branch a smart shake, and they will fall in front of the hive, and as soon as they perceive it, will enter. If the branch be of no value it can be cut off, placed under the hive, and the bees will ascend in a few minutes. As soon as all are in, the hive should be placed in the position, or upon the stand it is to occupy, and protected from the heat of the sun. Second swarms issue in about ten days from the first, and the third in two or three days after the second. The hive should be left unplained on the inside, and before putting a swarm into it, washed out with salt and water.

That California is admirably adapted to the honey bee, the experience of five years fully demonstrates. Not only in San Jose Valley, but at Sacramento, Shasta, Bidwell's, Stockton, Columbia and Napa, they multiply rapidly and store abundance of honey. The willow affords the first material for pollen. The bees commence gathering it by the 1st of January; about the 15th of January it is in bloom and affords considerable honey, though slightly bitter; the bees gather pollen and honey from the willow till Marc[illegible] The wild mustard affords an inexhaustib[illegible]y of honey from the last of April to the [illegible] June. La[illegible] in the season, honey is c[illegible] and honey dew.

[illegible] immigrant brough[illegible] [illegible]arm of bees ev[illegible] had two sw[illegible]

Wm. [illegible]

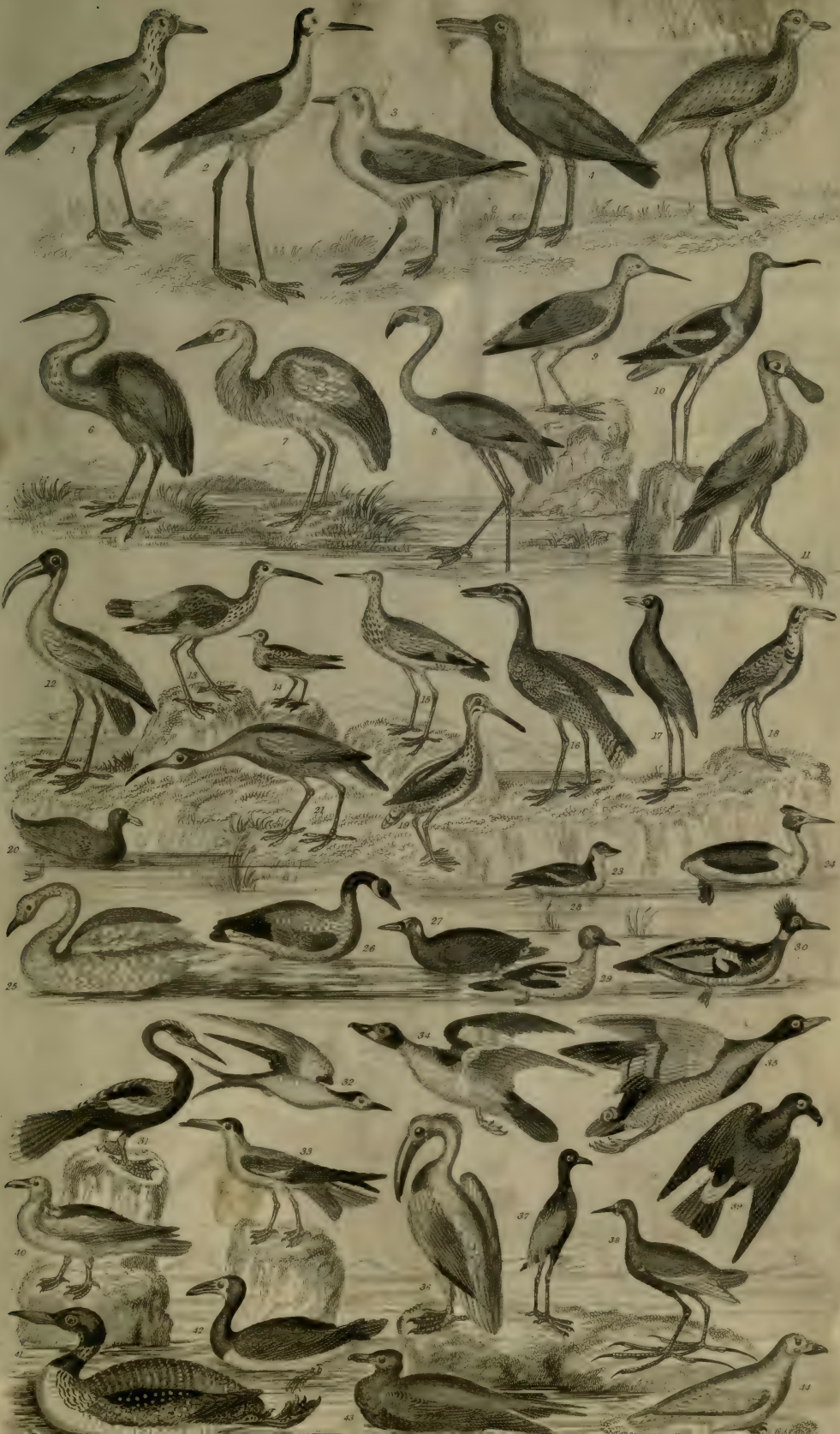
ter to L. S. Lang[illegible]

"The Russia and Hungary Ap[illegible] ing from 2,000 to 5,000 colonies, are be unfrequent; and we know tha[illegible] 4,000 hives are oftentimes cong[illegible] point on the heaths of Germany. [illegible] we need not fear that any district [illegible] try, so distinguished for abundant na[illegible] tation and diversified culture, will ver[illegible] be overstocked.

"According to the statistical tables [illegible] kingdom of Hanover, the annual productio[illegible] bees' wax in the province is 300,000 pounds assuming one pound of wax to each hive, we must suppose 3000,000 hives are annually 'brimstoned;' and assuming one-half of the whole colonies produce a swarm each year, it would require 600,000 colonies (141 to each square mile), to secure the result given in the tables.

"In the province of Attica, Greece, containing forty-five square miles, and 20,000 inhabitants, 20,000 hives of bees are kept; yielding thirty pounds of honey, and two of wax: one hive to each man, woman and child."—*Langstroth, p.* 398.

"East Friesland, a province of Holland, containing 1,200 square miles, maintained 2,000 colonies per square mile."—*Henbel, Beinen zeitung*, 1854, *p.* 11.


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Daily Evening Bulletin.

THOMAS S. KING, EDITOR.

MONDAY EVENING, MARCH 29, 1858.

The Fossil Formations of California.

EDITOR OF THE SAN FRANCISCO EVENING BULLETIN:—Probably no country in the world abounds with such an infinite variety of the extinct animals of creation as the State of California; certainly in no district of country on the globe are they to be met with in such extraordinary abundance as on our hill-tops, mountain-sides and valleys. Nor is it confined to one kingdom of nature, but includes molluscous shells, fish, land animals, such as mastodons, wolves, whales, deer, and some say even man. Fossil vegetation is often found by the miners in their claims as well as animal remains. In the section of country lying between the Tulare plains, west to the ocean, and including a radius of seventy miles in diameter from the Mission of Soledad, in Monterey county, to the town of San Luis Obispo, whole mountains are found of immense oysters and of a multitudinous variety of the extinct mollusca, in the most extraordinary state of preservation, as perfect as if washed ashore yesterday, excepting in the matter of color, flesh and weight.

In the fifth volume of Railroad Surveys, may be found the report on the topography of that section of California—inland *via* the Tulare plain—from Benicia to Fort Yuma, written by the commanding officer, Lt. R. S. Williamson—a work in itself of great merit, full of views and illustrations, and in a high degree creditable to that officer and his assistants. The scientific report on the geology, fossiliferæ, mineralogy, etc., of Williamson's Survey is written by Professor William P. Blake, who accompanied the expedition as geologist. In this work may be found splendid illustrations of the fossils and plants, and many of the living mollusca, etc., of California, collected by the expedition, and described scientifically by Messrs. Conrad, Durand, Torrey, and others.

The report on geology, mineralogy, etc., by Blake, is a lasting monument to the industry, ability and ingenuity of this eminent Californian—one who is well known, not only in the scientific literature of California, but of the Atlantic States and Europe. The copious notes and observations on the physical aspects and *penetralia* of California, at once fix Mr. Blake as an observer and student of sterling capacities. He has also the merit of writing in a style to suit both popular and scientific tastes. Mr. Blake is also the author of a chapter on the geology of the coast of California, in the Coast Survey Report of 1855, which is not only deep and thorough, but eminently practical; being easily understood by amateurs of the science. Of all the writers on the physical nature of California, I conceive Mr. Blake is entitled to be classed as number one.

In reference to the fossil mollusca of our State, I am indebted to Dr. C. A. Canfield, of Monterey, for the following list of shells, found by him, while traveling in the Sierras of that county, and which will be found of great use in fixing the locality of species not mentioned in Blake's report.

A. S. T., of Monterey.

CATALOGUE OF FOSSIL MOLLUSCA FOUND IN THE MOUNTAINS OF SAN BENITO CREEK, MONTEREY COUNTY.

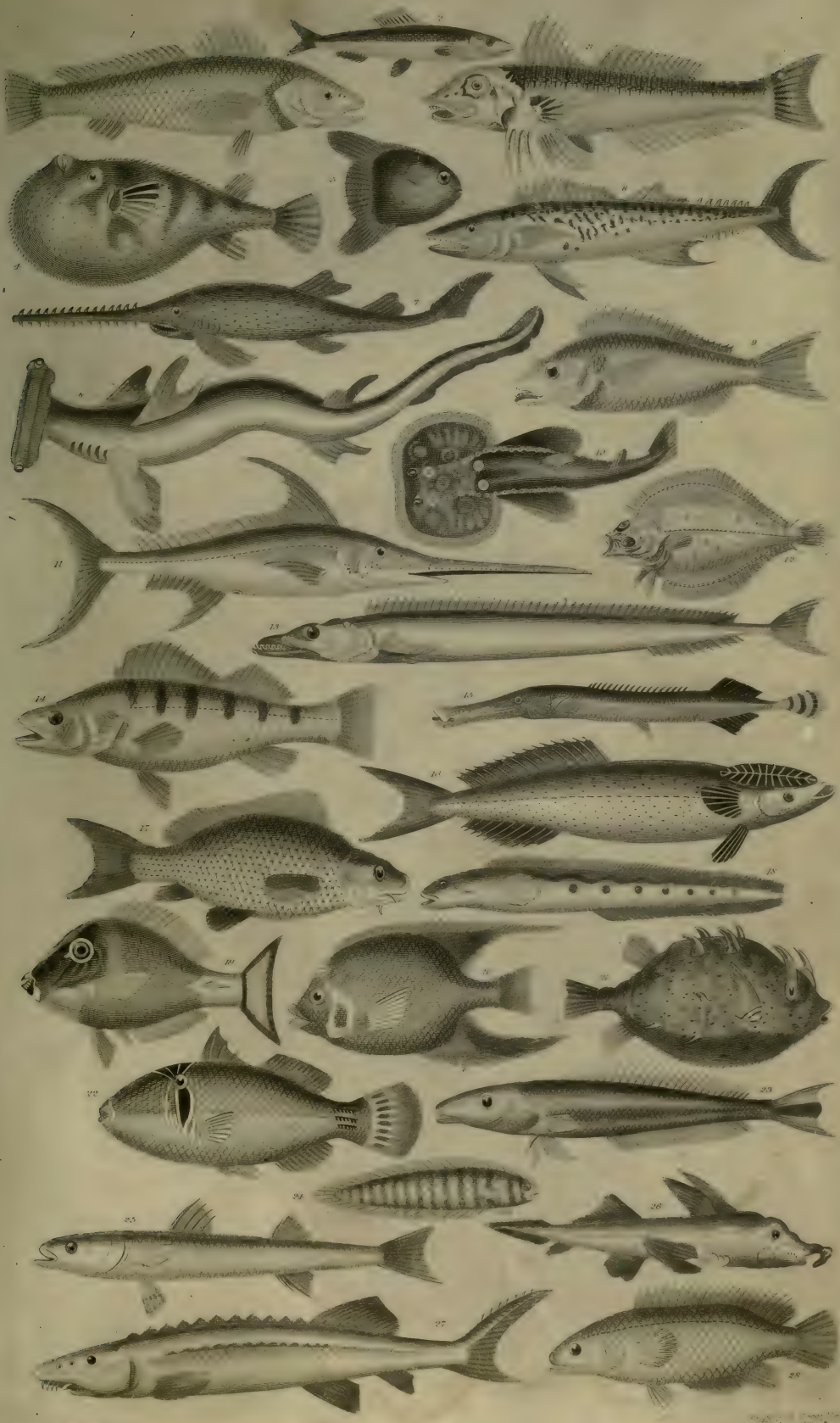
In the yellow limestone, of the Cañada del Topo and vicinity, the following species occur:

1. Bucania, species undetermined.
2. Murchisonia Bellicinta.
3. Macrocheilus, species undetermined.
4. Terebratula Chactavensis.
5. Pectin Quadricrustatis.
6. Janira Quadricastata.
7. Spirifer Fasciger.
8. Ostrea, several species.
9. Faviphyllum Rugosum.
10. Faphrentis Multilamella.
11. Faph. Stansburii.

In the sandy limestone formations, cut through he San Benito creek, occur the following species:

12. Holaster Simplex.
13. Lucina, several species.
14. Cuculloe Nebrascensis.
15. Allorisma Regularis.
16. Spirifer Octoplicata.
17. Gryphoea Pitcheri.
18. Gryphoe, 2 other species undetermined.
19. Productus Cora.
20. Tarebratula, undetermined.
21. Holopea, undetermined.
22. Bacculitis Compressis.
23. Ancella Crassicollis.
24. Murex, undetermined.
25. Melanea, undetermined.
26. Trochus, undetermined.
27. Pterocerus, undetermined.
28. Isocardia, undetermined.
29. Natica, undetermined.
30. Ostrea, several species.
31. Turritella, undetermined.
32. Donax, undetermined.
33. Trygonia, undetermined.
34. Pholadomia, undetermined.
35. Exogyra, undetermined.
36. Rostellaria, undetermined.
37. Solen Vagina.
38. Anotina Convexa.
39. Halistis Tuberculata.
40. Tellina Congesta.
41. Lutraria Compressa.
42. Pertunculus Castatus.
43. Buccinum Prisc[illegible]

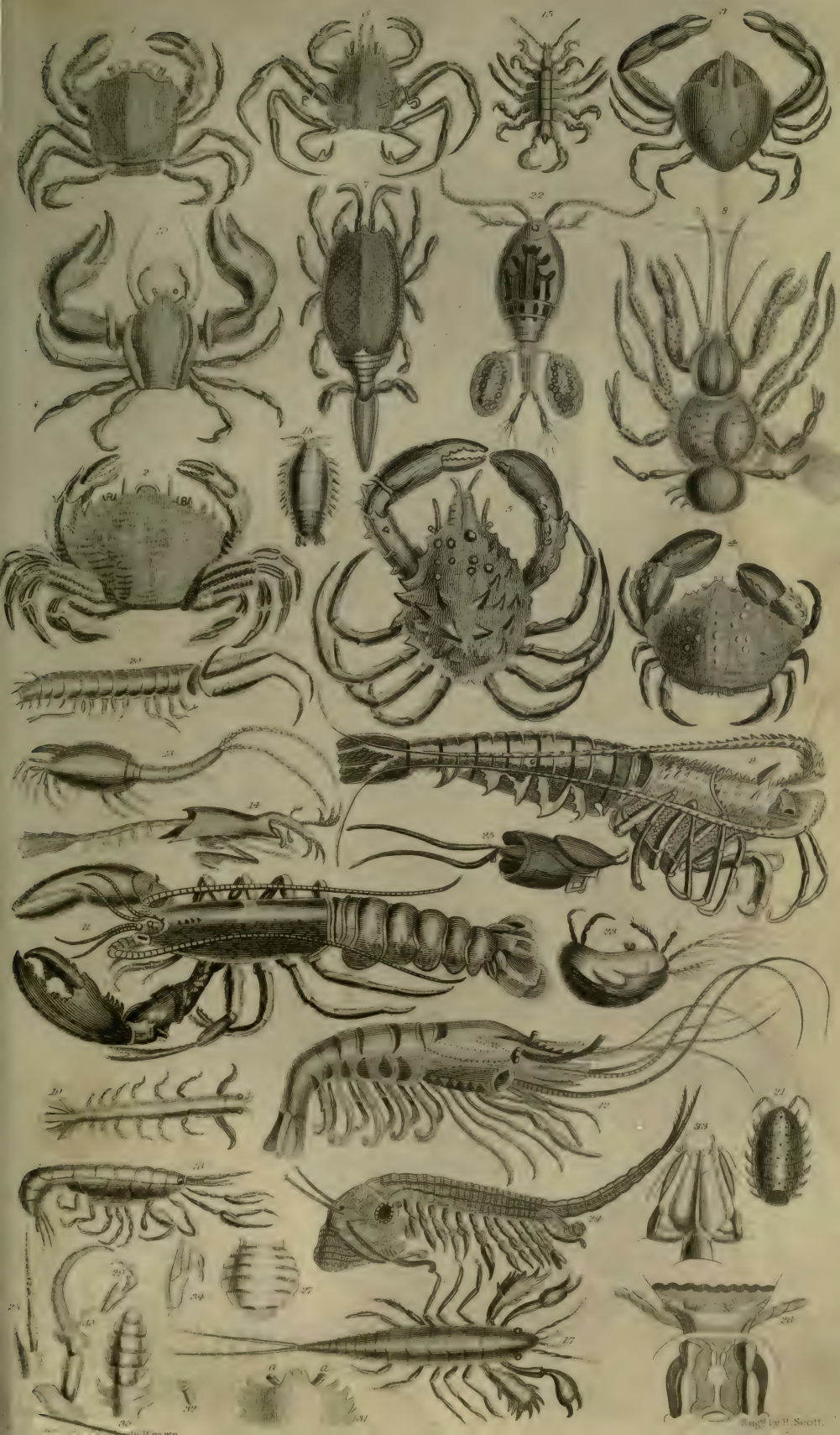




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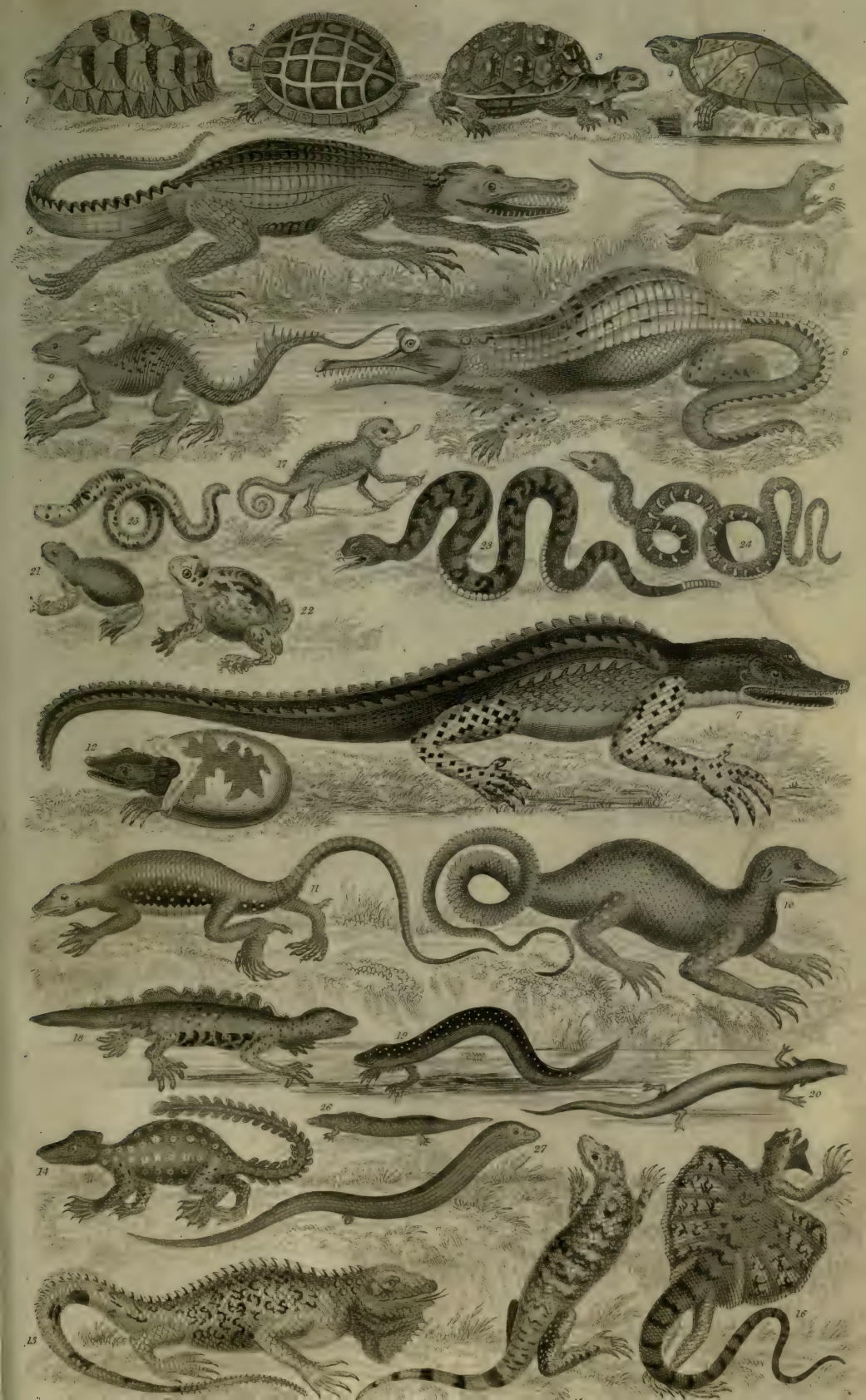
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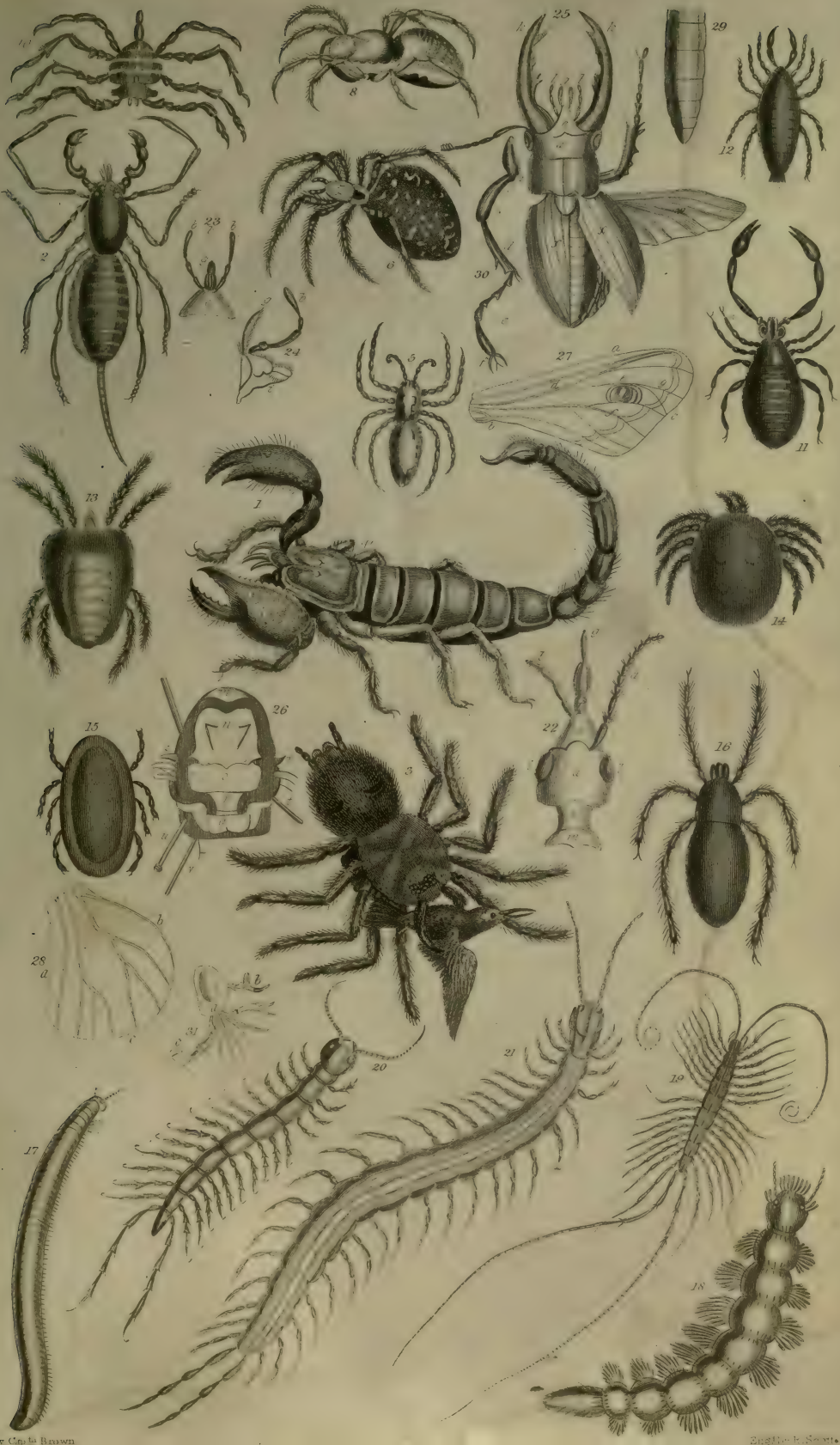

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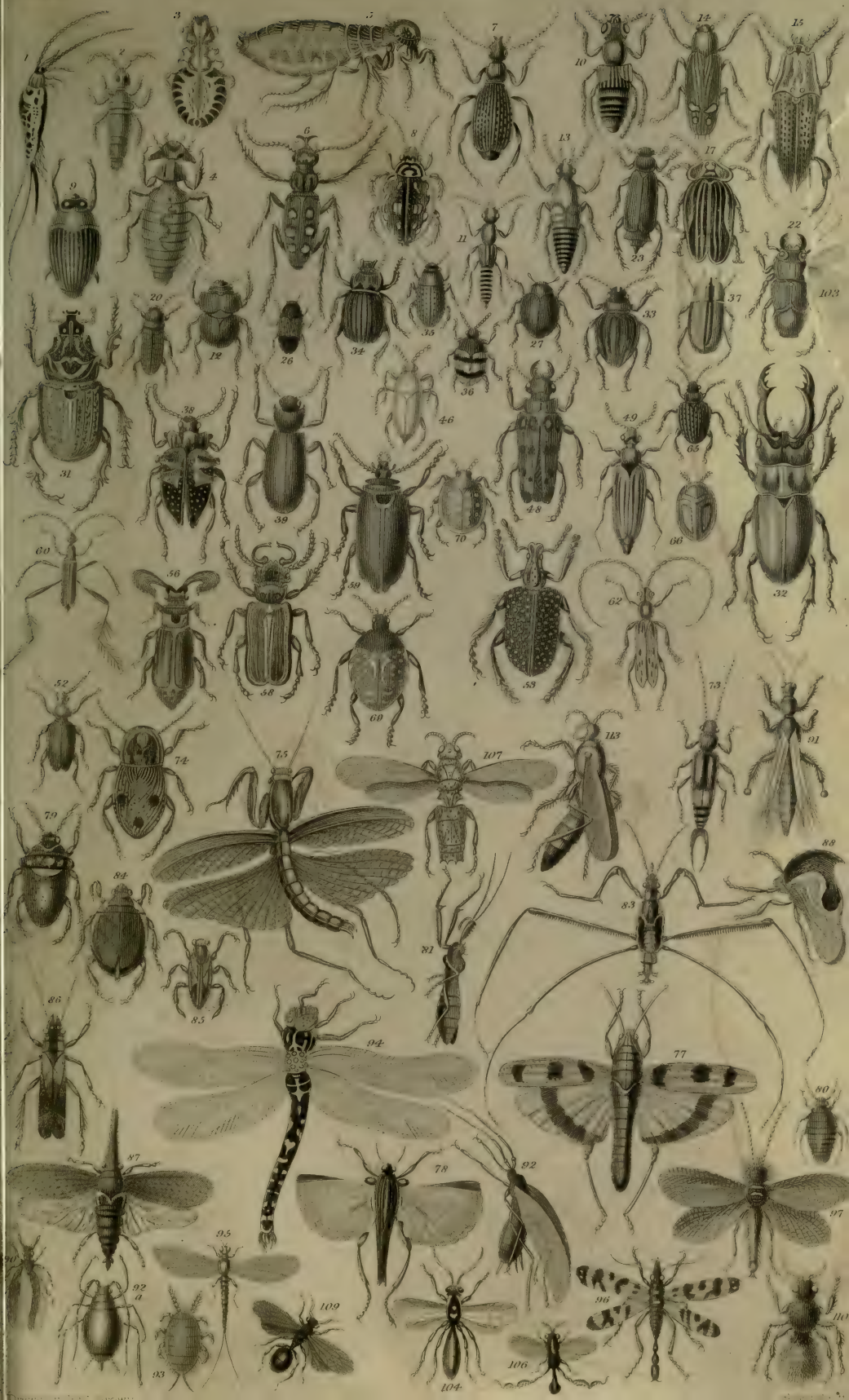
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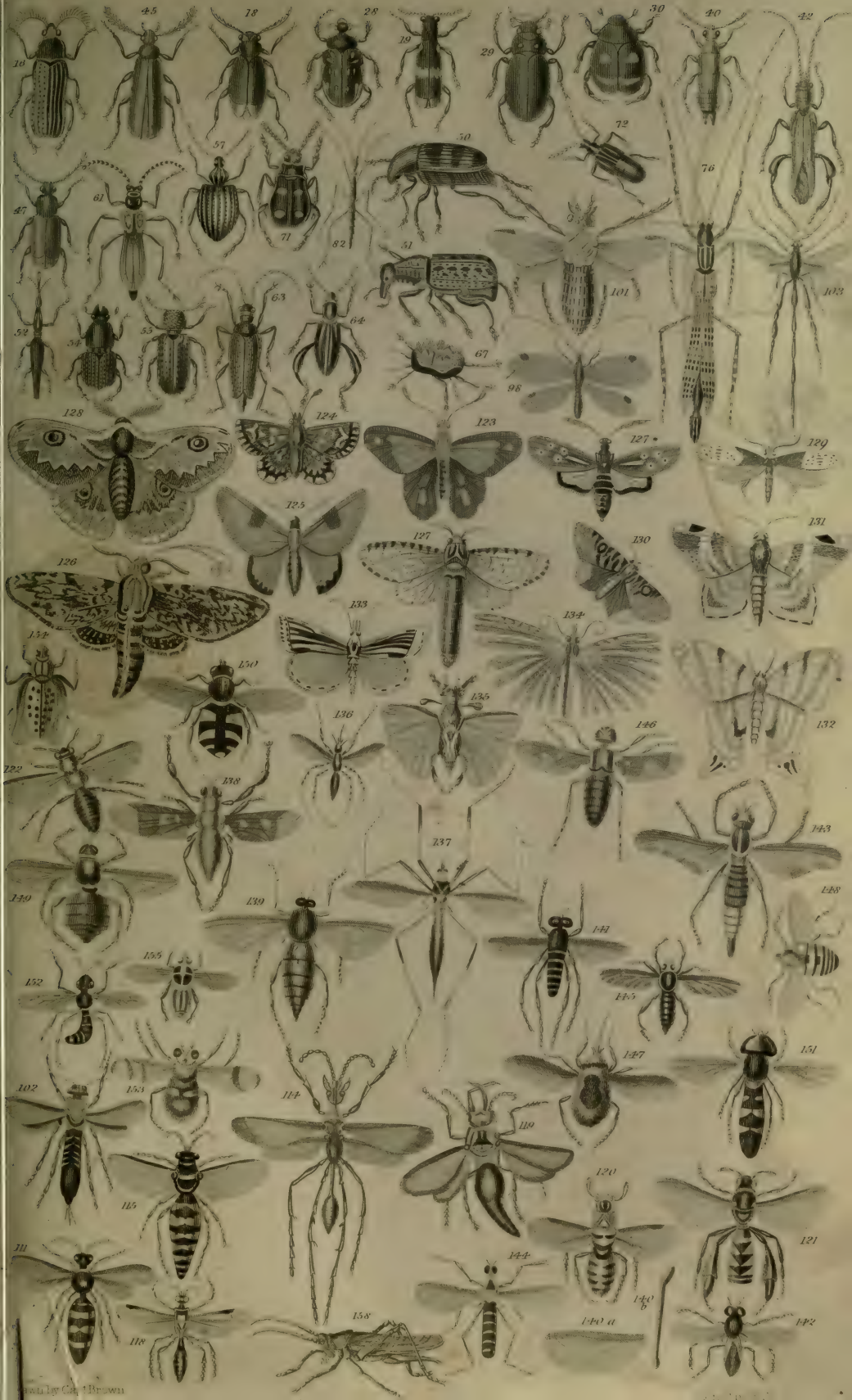



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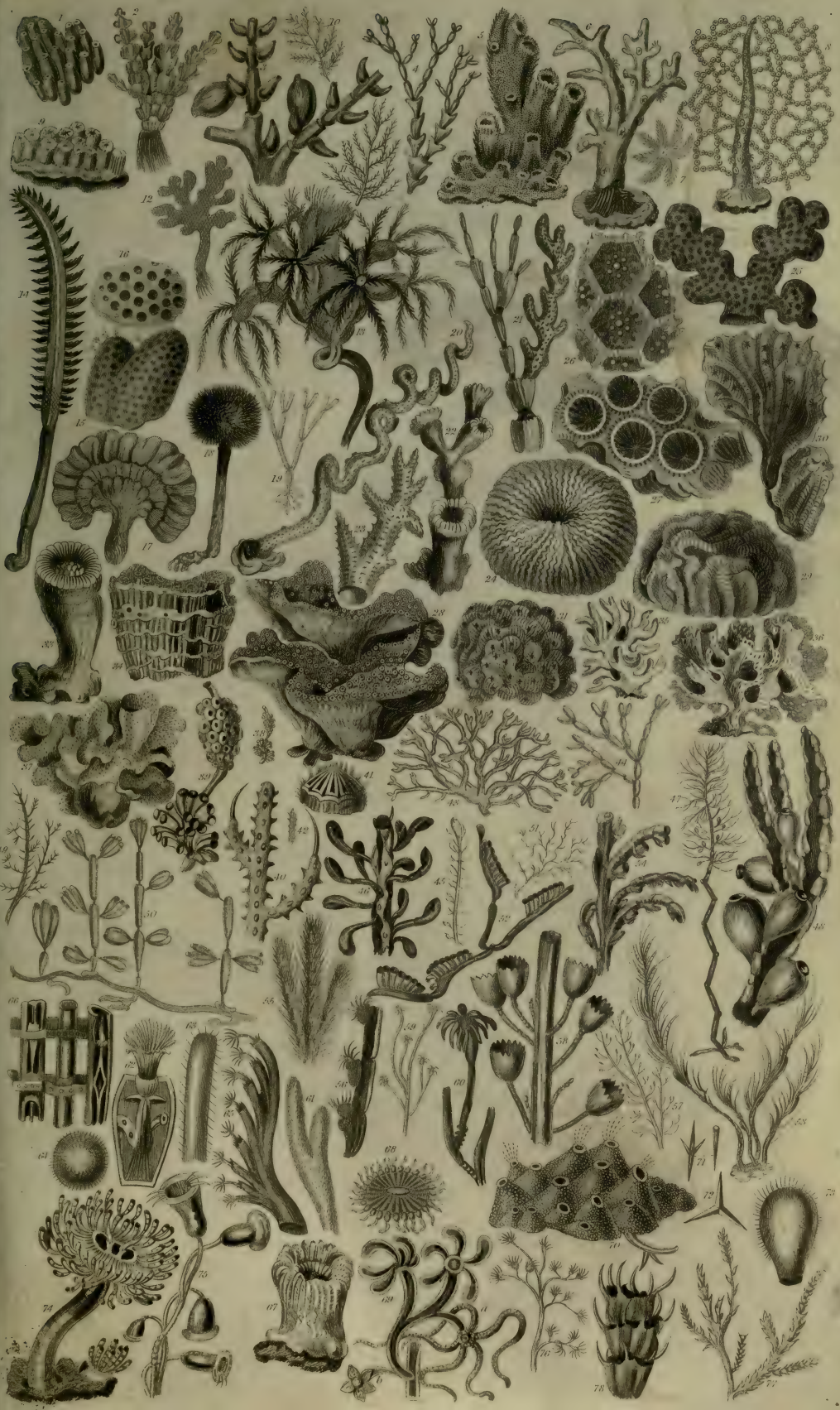

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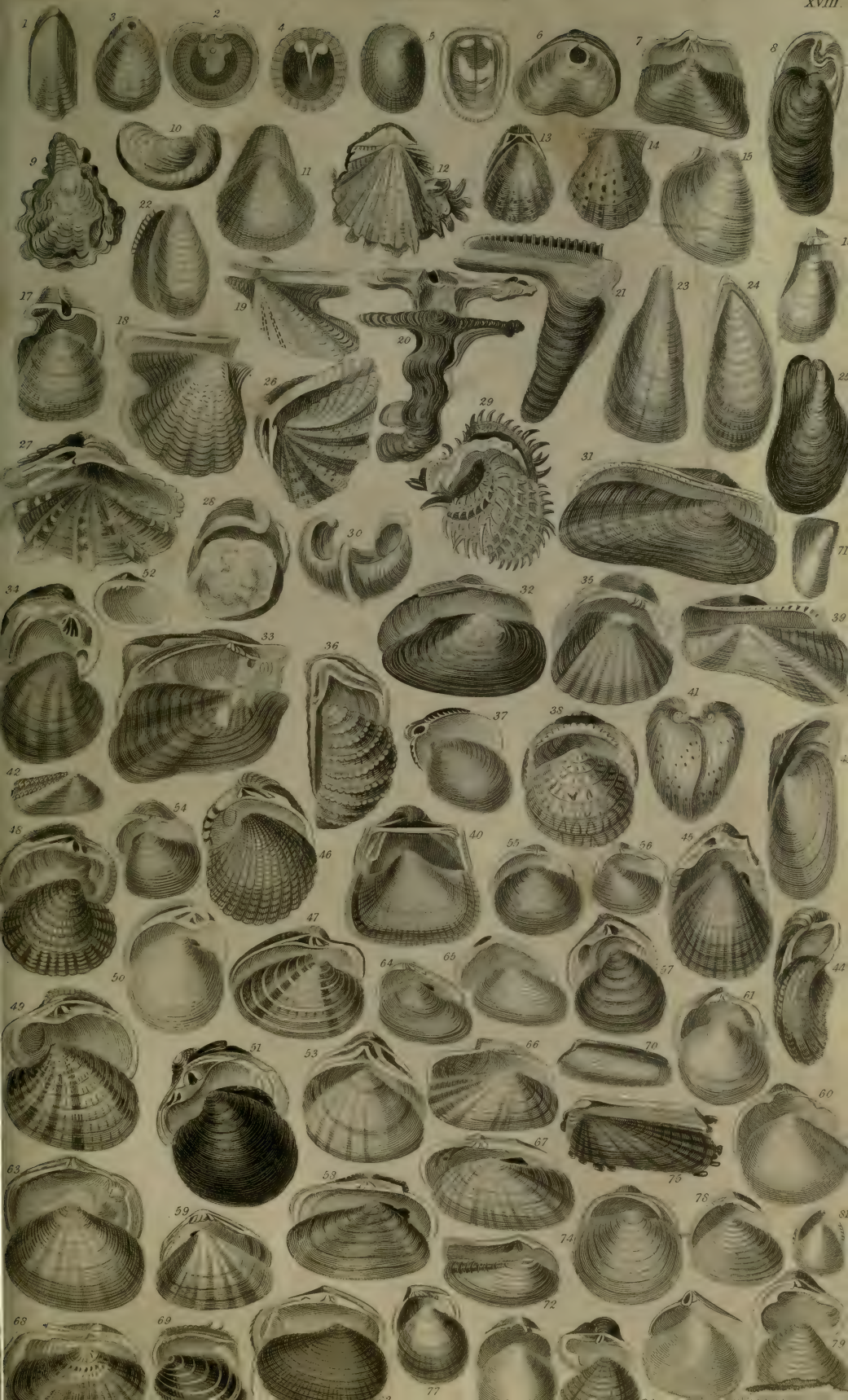

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Drawn by Geo. Brown







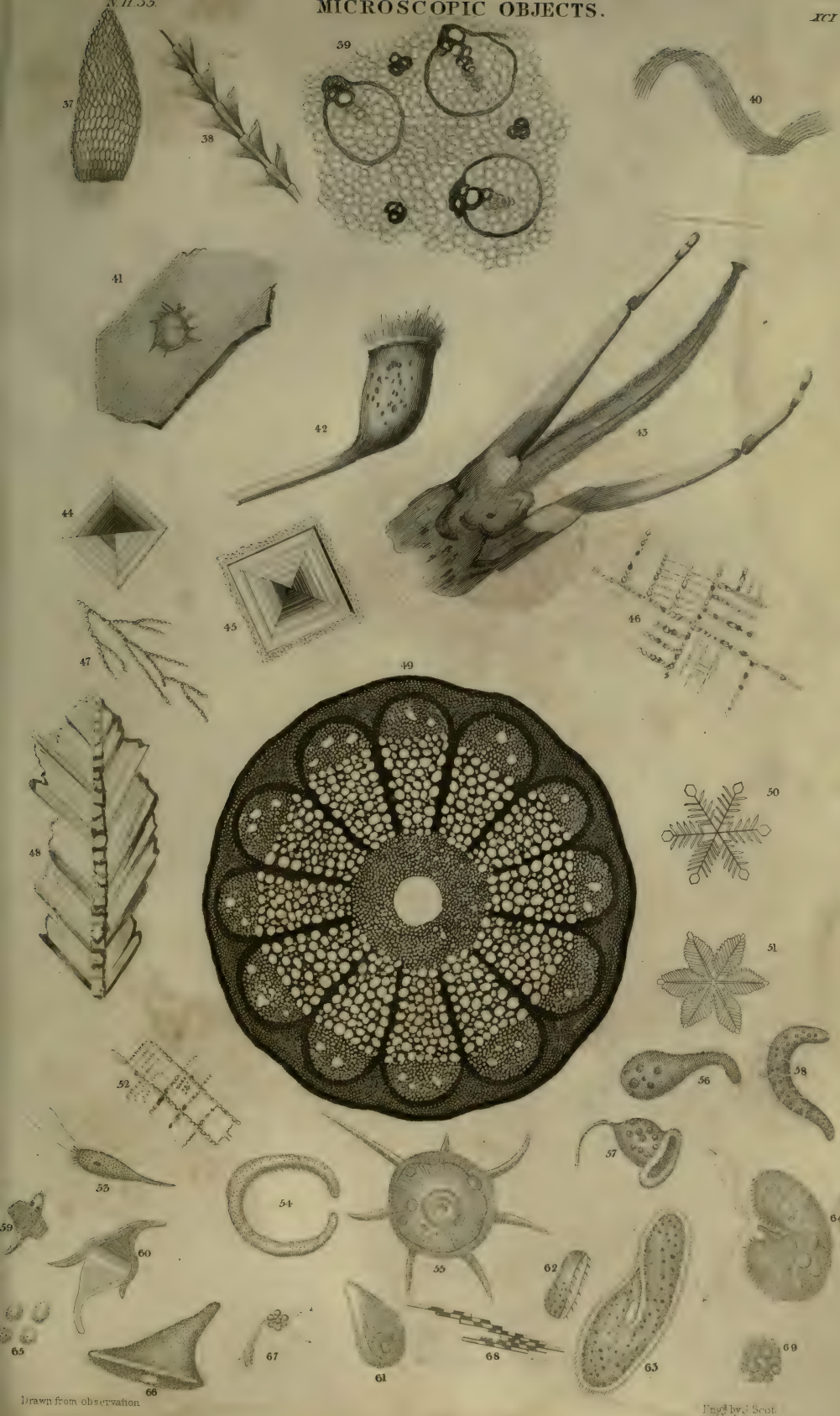




Drawn from observation

Eng.ᵈ by J. Scott

Published by Blackie & Son Glasgow



Drawn from observation

Engd by J. Scot

Published by Blackie & Son Glasgow

A

HISTORY OF BIRDS.

BOOK I.

OF BIRDS IN GENERAL.

CHAP. I.

INTRODUCTION.

We are now come to a beautiful and loquacious race of animals, that embellish our forests, amuse our walks, and exclude solitude from our most shady retirements. From these man has nothing to fear; their pleasures, their desires, and even their animosities, only serve to enliven the general picture of nature, and give harmony to meditation.

No part of nature appears destitute of inhabitants. The woods, the waters, the depths of the earth, have their respective tenants; while the yielding air, and those tracts of seeming space where man never can ascend, are also passed through by multitudes of the most beautiful beings of the creation.

Every order and rank of animals seems fitted for its situation in life; but none more apparently than birds: they share, in common with the stronger race of quadrupeds, the vegetable spoils of the earth; are supplied with swiftness, to compensate for their want of force; and have a faculty of ascending into the air, to avoid that power which they cannot oppose.

The birds seem formed entirely for a life of escape; and every part of the anatomy of the animal seems calculated for swiftness. As it is designed to rise upon air, all its parts are proportionably light, and expand a large surface without solidity.

In a comparative view with man, their formation seems much ruder and more imperfect; and they are in general found incapable of the docility even of quadrupeds. Indeed, what degree of sagacity can be expected in animals whose eyes are almost as large as their brain? However, though they fall below quadrupeds in the scale of nature, and are less imitative of human endowments; yet they hold the next rank, and far surpass fishes and insects, both in the structure of their bodies and in their sagacity.

As in mechanics the most curious instruments are generally the most complicated, so it is in anatomy. The body of man presents the greatest variety upon dissection; quadrupeds, less perfectly formed, discover their defects in the simplicity of their conformation; the mechanism of birds is still less complex; fishes are furnished with fewer organs still; whilst insects, more imperfect than all, seem to fill up the chasm that separates animal from vegetable nature. Of man, the most perfect animal, there are but three or four species; of quadrupeds, the kinds are more numerous; birds are more various still; fishes yet more; but insects afford so very great a variety, that they elude the search of the most inquisitive pursuer.

Quadrupeds, as was said, have some distant resemblance in their internal structure with man; but that of birds is entirely dissimilar. As they seem chiefly formed to inhabit the empty regions of air, all their parts are adapted to their destined situation. It will be proper, therefore, before I give a general history of birds, to enter into a slight detail of their anatomy and conformation.

As to their external parts, they seem surprisingly adapted for swiftness of motion. The shape of their body is sharp before, to pierce and make way through the air; it then rises by a gentle swelling to its bulk, and falls off in an expansive tail, that helps to keep it buoyant, while the fore-parts are cleaving the air by their sharpness. From this conformation, they have often been compared to a ship making its way through water; the trunk of the body answers to the hold, the head to the prow, the tail to the rudder, and the wings to the

oars; from whence the poets have adopted the metaphor of *remigium alarum*, when they described the wavy motion of a bird in flight.

What we are called upon next to admire in the external formation of birds is, the neat position of the feathers, lying all one way, answering at once the purposes of warmth, speed, and security. They mostly tend backward, and are laid over one another in an exact and regular order, armed with warm and soft down next the body, and more strongly fortified, and curiously closed externally, to fence off the injuries of the weather. But, lest the feathers should spoil by their violent attrition against the air, or imbibe the moisture of the atmosphere, the animal is furnished with a gland behind, containing a proper quantity of oil, which can be pressed out by the bird's bill, and laid smoothly over every feather that wants to be dressed for the occasion. This gland is situated on the rump, and furnished with an opening or excretory duct; about which grows a small tuft of feathers somewhat like a painter's pencil. When, therefore, the feathers are shattered or rumpled, the bird, turning its head backwards, with the bill catches hold of the gland, and, pressing it, forces out the oily substance, with which it anoints the disjoined parts of the feathers; and drawing them out with great assiduity, recomposes and places them in due order; by which they unite more closely together. Such poultry, however, as live for the most part under cover, are not furnished with so large a stock of this fluid, as those birds that reside in the open air. The feathers of a hen, for instance, are pervious to every shower; on the contrary, swans, geese, ducks, and all such as Nature has directed to live upon the water, have their feathers dressed with oil from the very first day of their leaving the shell. Thus their stock of fluid is equal to the necessity of its consumption. Their very flesh contracts a flavour from it, which renders it in some so very rancid, as to make it utterly unfit for food; however, though it injures the flesh, it improves the feathers for all the domestic purposes to which they are usually converted.

Nor are the feathers with which birds are covered less an object of admiration. The shaft of every feather is made proportionably strong; but hollow below for strength and lightness, and above filled with a pith to feed the growth of the vane or beard that springs from the shaft of the feather on either side. All the feathers are placed generally according to their length and strength, so that the largest and strongest feathers in flight have the greatest share of duty. The vane or beard of the feather is formed with equal contrivance and care. It consists not of one continued membrane; because, if this were broken, it could not easily be repaired; but it is composed of many layers, each somewhat in itself resembling a feather, and lying against each other in close conjunction. Towards the shaft of the feather, these layers are broad, and of a semicircular form, to serve for strength, and for the closer grafting them one against the other when in action. Towards the outer part of the vane, these layers grow slender and taper, to be more light. On their under-side they are thin and smooth, but their upper outer-edge is parted into two hairy edges, each side having a different sort of hairs, broad at bottom, and slender and bearded above. By this mechanism, the hooked beards of one layer always lie next the straight beards of the next, and by that means lock and hold each other.[1]

[1] All birds are covered with feathers, and they are the only animals which, properly speaking, are so. These feathers are of two sorts—feathers for clothing, to protect the animal from the vicissitudes of the weather, and feathers for flight. Both of these are beautifully modified, so as to suit the different habits of the several species, and adapt them to the climates and the elements in which they find their food.

Some other animals, as for instance the lepidopterous insects—the butterflies and the moths—have a coat of feathers, or rather of fringed or feathery scales; but these have few or none of the characters of true feathers, and in no case, except that of birds, are feathers the instruments of flight. But still we can, in the imperfect feathers of the lepidoptera, discover one of the uses of feathers in birds better than we can perhaps do in the feathers of birds themselves, as in them it is conjoined with other uses. The study of one animal often assists us in acquiring a knowledge of another, especially when the one contains a single part of that which is a compound organ in another; because by this means we get an analysis of the living animal, which is far more satisfactory than any that we could obtain by the dissection of a dead one; for we can, in the one case, actually see the part of the organ in action, whereas in the other we can only infer or guess at the way in which it acts.

Now, every one must have noticed, that bees, flies, and all insects which have membranous or naked wings, must keep those wings constantly in rapid motion while they fly. The motion is often so rapid that the wings cannot be seen, any further than by a sort of tremulous motion in the air; and the action of the wings produces all that humming and buzzing among flying insects which makes the summer air so lively; for insects do not breathe by the mouth, and have no organ of voice of any description. The action of those naked wings upon the air must be very considerable; because, when a common bluebottle-fly (*Musca vomitoria*) alights on the window, and marches along one of the dusty bars of the frame, winnowing the air with its wings, in a vain attempt to escape through the glass, it stirs the dust more in proportion than a coach and six driving rapidly along a dry road on a hot summer's day. Insects with wings of this description cannot *hover*, or lean on the air with still and expanded wing.

But the lepidoptera, especially the butterflies, do hover about, and rest on the air, and wheel in various directions, with very little apparent motion of the wings; and when they do move them, it is done much more slowly than the motion of the naked wing, in proportion to the rate of progressive motion. These lepidopterous

The next object that comes under consideration, in contemplating an animal that flies, is the wing, the instrument by which this wonderful progression is performed. In such birds that fly, they are usually placed at that part of the body which serves to poise the whole, and support it in a fluid that at first seems so much lighter than itself. They an-

wings also move in silence, or when they are brought into such rapid action as to produce a sort of noise, it is a low and muffled rustle, and does not ring out, so that the largest butterfly or moth gets along much more silently than the gnat. We may add, as a further instance of the same kind, that the bats when they fly are always obliged to winnow the air with their flying membranes, something in the same way as naked winged insects do, though the flight of bats, unless when they are agitated, is comparatively noiseless. So also those reptiles which fly by means of membranous appendages are obliged to flutter these very much in proportion to the rate of their progressive motion.

Now, the difference of action in these two textures of wings in the other classes of animals, shows us the advantages which birds derive from their feathery covering and feathery organs of flight. These feathers, even to the minutest fibre on the plumes or webs, are tubular, consisting of only a thin film of solid matter, filled with air within, though strengthened by partitions of cellular substance, more or less close together, according to the strain which the feathers have to bear. From the mode in which the feathers and all their parts are laid upon the bird, it presents a smooth surface upwards and forwards, so that the animal can move in either of these directions with very little resistance from the friction of the air. When it moves in either of them, the resistance of friction does not increase so rapidly as the rate of motion; because the pressure smooths the feathers, and causes the air to take less hold of them. This property, which arises in part from the texture of the upper surface of the feathers, but chiefly from the way in which they are formed and placed, is of equal service to birds when they must perch or otherwise remain at rest so as to abide the blast, as when they fly exposed to it. Perching or flying, when a bird is in the wind it always faces the current, and thus offers the least resistance both by its form and its feathers.

When, however, the feathers are taken in the opposite directions, they offer as much increase of resistance as they offer diminution when they are taken above or in front. The wings are always more or less hollow on the under sides, and they take hold of the air by millions of fibres, so that a bird with its flying feathers on the stretch, would fall much more slowly than one would suppose from the difference between its specific gravity and that of the air.

The resistance which all the feathers on the body of the bird offer to motion backwards is still greater; and it increases with the force which tends to move the animal in that direction. The instant that it begins to be driven backwards, so that a current against its body is produced, the points of the feathers rise and take the wind with so many fibres, that the resistance is very similar to that made by a scaly fish, when one attempts to draw one of these by the tail; and every one who has angled, and accidentally caught even a common trout in that way, knows that an ounce weight is as difficult to land when so hooked as a pound weight is when hooked by the head. But the feathers of birds rise much more in proportion than the free edges of the scales upon any fish, and they are every way as well formed for "holding on" in the air, as those are for holding on in the water. Thus the bird may be said to resist motion backwards in the air, by throwing out the point of each feather like the "fluke" of an anchor.

The bird, when its habit is to be much on the wing, is all over adapted for flight; and the system of its mechanics, if we could fully comprehend it, would certainly be the most curious, and far from the least instructive, in the whole of the animal kingdom.

The buoyancy, as well as the upward motion, is not very difficult to understand, because the wing, from its general form, and the structure of the feathers, rises with much less effort than it descends. Thus the constant tendency of the powerfully winged bird is to mount upwards; and on this account the firmest bird, that which with the same volume of body and extent of wings has the greatest specific gravity, is the best flyer, flies more steadily, and apparently with less effort. This must of course have a limit; because, leaving the incapacity of breathing out of the question, no bird could fly in a vacuum, and thus there must be a certain density of air which is the best adapted for the flight of any given species of bird. This appears, even in the case of heavy birds, to be considerably less than the density of the mean level of the earth's surface. Eagles are heavy birds, even for their powerful wings, and yet they are high fliers, even when their abodes are at great elevations in the mountains. All birds which take long flights fly high, whatever may be their other habits. Wild geese, herons, all birds indiscriminately "take the sky" when they set out upon long journeys. In some, this may be in part done to avoid enemies or obstacles, but the habit is too general for being accounted for upon any principle, save that the high flight is the less fatiguing. Even rooks may be observed to adjust the height of their daily excursions from the rookeries to the distance at which the pasture upon which they are to feed lies; and the swallow tribe wheel about far more rapidly and gracefully when they hawk high before rain, than when they skim the surfaces of the pools in fine weather. If we may judge from their appearance when we see them on the wing (the only means we have of judging), it appears that birds, when they are not in search of any thing upon the ground near them, mount up till they come to that density of atmosphere which is best suited to their weight and wings, and then continue onwards. There may be another reason: those upper regions to which the birds ascend on their long flights are in a great measure exempted from the momentary gusts and squalls which war upon the surface under them.

The circulation of blood is, as has been hinted already, more rapid in birds than in the mammalia, which agrees with the greater violence and longer continuance of some of their actions. But though these more violent actions —such as coursing on two feet, as fleetly as antelopes do on four, and with the aid of the flexible spine and its muscles, as in the ostrich—plunging into the water like the gannet or the cormorant—dashing through that element like the divers—cleaving the air beyond comparison with all terrestrial speed, as in the falcon, the swift, or the pratincole, or breasting the tempest with the majesty of the eagle—require, and are furnished with, a supply of blood proportional to the waste which their great energy must occasion; yet they are by no means so well suited to an equally rapid breathing by means of lungs. But the application of renovating air to the blood must, in all animals, be proportional to the circulation, and, among vertebrated animals, it is only the reptiles and fishes which have the temperature low and the circulation lagging, and which spend much of their time in a state of comparative inaction, that can carry on their systems in a healthy state with only a partial aëration of the blood.

If the subject is considered according to our plans in contriving and executing, there is thus a difficulty to be overcome in the case of the birds, similar to which no-

swer to the fore-legs in quadrupeds, and at the extremity of this they have a certain finger-like appendix, which is usually called the *bastard-wing*. This instrument of flight is furnished with quills, which differ from the common feathers only in their size being larger, and also from their springing from the deeper part of the skin, their shafts lying almost close to the bone. The beards of these quills are broad on one side and more narrow on the other, both which contribute to the progressive motion of the bird, and the closeness of the wing. The manner in which most birds avail themselves of these, is first thus: they quit the earth with a bound, in order to have room for flapping with the wing; when they have room for this, they strike the body of air beneath the wing with a violent motion, and with the whole under surface of the same; but then to avoid striking the air with equal violence on the upper side as they rise, the wing is instantly contracted; so that the animal rises by the impulse, till it spreads the wing for a second blow. For this reason, we always see the birds choose to rise against the wind, because they have thus a greater body of air on the under than the upper side of the wing. For this reason also large fowls do not rise easily; both because they have not sufficient room at first for the motion of their wings, and because the body of air does not lie so directly under the wing as they rise.

In order to move the wings, all birds are furnished with two very strong pectoral muscles, which lie on each side of the breast-bone. The pectoral muscles of quadrupeds, are trifling in comparison to those of birds. In quadrupeds, as well as in man, the muscles which move the thighs and hinder parts of the body are by far the strongest, while those of the arms are feeble; but in birds, which make use of their wings, the contrary obtains; the pectoral muscles, that move the wings or arms, are of enormous strength, while those of the thighs are weak and slender. By means of these, a bird can move its wings with a degree of strength which, when compared to the animal's size, is almost incredible. The flap of a swan's wing would break a man's leg; and a similar blow from an eagle has been known to lay a man dead in an instant. Such, consequently, is the force of the wing, and such its lightness, as to be inimitable by art. No machines, that human skill can contrive, are capable of giving such force to so light an apparatus. The art of flying, therefore, that has so often and so fruitlessly been sought after, must, it is feared, for ever be unattainable; since as man increases the force of his flying machine, he must be obliged to increase its weight also.

In all birds, except nocturnal ones, the head is smaller, and bears less proportion to the body than in quadrupeds, that it may more readily divide the air in flying, and make way for the body, so as to render its passage more easy. Their eyes also are more flat and depressed than in quadrupeds; a circle of small plates of bone, placed scalewise, under the outer coat of the organ, encompasses the pupil on each, to strengthen and defend it from injuries. Besides this, birds have a kind of skin, called the nictitating membrane, with which, like a vail, they can at pleasure cover their eyes, though their eye-lids continue open. This membrane takes its rise from the greater or more obtuse corner of the eye, and serves to wipe, cleanse, and probably to moisten its surface. The eyes, though they outwardly appear but small, yet, separately, each almost equals the brain; whereas in man the brain is more than twenty times larger than the orbit of the eye. Nor is this organ in birds less adapted for vision by a particular expansion of the optic nerve, which renders the impressions of external objects more vivid and distinct.

From this conformation of the eye it follows, that the sense of seeing in birds is infinitely superior to that of other animals. Indeed this piercing sight seems necessary to the creature's support and safety. Were this organ blunter, from the rapidity of the bird's motion, it would be apt to strike against every object in its way; and it could scarcely find subsistence, unless possessed of a power to

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thing occurs in that of any of the other vertebrated animals. They stand more in need of the action of the air than any other animals; and their habits are such, that they are less able to bear even the same action, by means of the ordinary apparatus of lungs.

The means by which the action of the air on the blood of birds is rendered equal to the rapidity in circulation, and consequent necessity of vital repair in that fluid, without the painful fatigue of ever-panting lungs, is made, like all other contrivances in nature, to answer other important purposes at the same time. The lungs of birds are ample in their dimensions, and have the cells into which air is admitted larger than in the mammalia; and they are kept in their places by being fastened to the bones. Ramifications extend from them in tubes and cells through the whole cavity of the body, into the hollows of the bones, and, in short, along the course of every artery which is not immediately embedded in those muscles which are in action during the violent exertions of the bird. The blood-vessels in these muscles are fewer than those in the muscles of the mammalia, as any one may infer from the greater rigidity of their texture, and the whiteness of their colour. Thus, there is not a blood-vessel of any considerable size in the whole body of a bird, to the coats of which the air has not access during the greater part of their course; and thus the real action of breathing in birds is not concentrated into one organ, to be toiling and panting there, as it would be in the lungs of the mammalia, but distributed over the whole circulation, and consequently diminished in local intensity in proportion as it extended over a greater surface.—*Mudie's Natural History of Birds.*

discern its food from above with astonishing sagacity. A hawk, for instance, perceives a lark at a distance which neither men nor dogs could spy; a kite, from an almost imperceptible height in the clouds, darts down on its prey with the most unerring aim. The sight of birds, therefore, exceeds what we know in most other animals, and excels them both in strength and precision.

All birds want the external ear standing out from the head; they are only furnished with holes that convey sounds to the auditory canal. It is true, indeed, that the horned owl, and one or two more birds, seem to have external ears; but what bears that resemblance are only feathers sticking out on each side of the head, but no way necessary to the sense of hearing. It is probable, however, that the feathers encompassing the ear-hole in birds, supply the defect of the exterior ear, and collect sounds to be transmitted to the internal sensory. The extreme delicacy of this organ is easily proved by the readiness with which birds learn tunes, or repeat words, and the great exactness of their pronunciation.

The sense of smelling seems not less vivid in the generality of birds. Many of them *wind* their prey at an immense distance, while others are equally protected by this sense against their insidious pursuers. In decoys, where ducks are caught, the men who attend them universally keep a piece of turf burning near their mouths, upon which they breathe, lest the fowl should smell them, and consequently fly away. The universality of this practice puts the necessity of it beyond a doubt, and proves the extreme delicacy of the sense of smelling, at least in this species of the feathered creation.

Next to the parts for flight, let us view the legs and feet ministering to motion. They are both made light, for the easier transportation through the air. The toes in some are webbed, to fit them for the waters; in others they are separate, for the better holding objects, or clinging to trees for safety. Such as have long legs have also long necks, as otherwise they would be incapable of gathering up their food either by land or water. But it does not hold, however, that those who have long necks should have long legs, since we see that swans and geese, whose necks are extremely long, have very short legs, and these chiefly employed in swimming.

Thus every external part, hitherto noticed, appears adapted to the life and situation of the animal; nor are the inward parts, though less immediately appropriated to flight, less necessary to safety. The bones of every part of the body are extremely light and thin; and all the muscles, except that immediately moving the wings, extremely slight and feeble. The tail, which is composed of quill feathers, serves to counterbalance the head and neck; it guides the animal's flight, like a rudder, and greatly assists it either in its ascent or when descending.

If we go on to examine birds internally, we shall find the same wonderful conformation fitting them for a life in air, and increasing the surface by diminishing the solidity. In the first place their lungs, which are commonly called the *sole*, stick fast to the sides of the ribs and back, and can be very little dilated or contracted. But to make up for this, which might impede their breathing, the ends of the branches of the wind-pipe open into them, while these have openings into the cavity of the belly, and convey the air drawn in by breathing into certain receptacles like bladders, running along the length of the whole body. Nor are these openings obscure, or difficult to be discerned; for a probe thrust into the lungs of a fowl will easily find a passage into the belly; and air blown into the wind-pipe will be seen to distend the animal's body like a bladder. In quadrupeds this passage is stopped by the midriff; but in fowls the communication is obvious; and, consequently, they have a much greater facility of taking a long and large inspiration. It is sometimes also seen that the wind-pipe makes many convolutions within the body of a bird, and it is then called the *labyrinth*; but of what use these convolutions are, or why the wind-pipe should make so many turnings within the body of some birds, is a difficulty for which no naturalist has been able to account.

This difference of the wind-pipe often obtains in animals that, to all appearance, are of the same species. Thus in the tame swan, the wind-pipe makes but a straight passage into the lungs; while in the wild swan, which to all external appearance seems the same animal, the wind-pipe pierces through the breast-bone, and there has several turnings before it comes out again, and goes to enter the lungs. It is not to form the voice that these turnings are found, since the fowls that are without them are vocal; and those, particularly the bird just now mentioned, that have them, are silent. Whence, therefore, some birds derive that loud and various modulation in their warblings, is not easily to be accounted for; at least the knife of the anatomist goes but a short way in the investigation. All we are certain of is, that birds have much louder voices, in respect to their bulk, than animals of any other kind; for the bellowing of an ox is not louder than the scream of a peacock.

In these particulars, birds pretty much resemble each other in their internal conforma-

tion; but there are some varieties which we should more attentively observe. All birds have, properly speaking, but one stomach; but this is very different in different kinds. In all the rapacious kinds that live upon animal food, as well as in some of the fish-feeding tribe, the stomach is peculiarly formed. The œsophagus, or gullet, in them, is found replete with glandulous bodies, which serve to dilate and macerate the food, as it passes into the stomach, which is always very large in proportion to the size of the bird, and generally wrapped round with fat, in order to increase its warmth and powers of digestion.

Granivorous birds, or such as live upon fruits, corn, and other vegetables, have their intestines differently formed from those of the rapacious kind. Their gullet dilates just above the breast-bone, and forms itself into a pouch or bag, called the crop. This is replete with salivary glands, which serve to moisten and soften the grain and other food which it contains. These glands are very numerous, with longitudinal openings, which emit a whitish and a viscous substance. After the dry food of the bird has been macerated for a convenient time, it then passes into the belly, where, instead of a soft, moist stomach, as in the rapacious kinds, it is ground between two pair of muscles, commonly called the gizzard, covered on the inside with a stony, ridgy coat, and almost cartilaginous. These coats rubbing against each other, are capable of bruising and attenuating the hardest substances, their action being often compared to that of the grinding teeth in man and other animals. Thus the organs of digestion are in a manner reversed in birds. Beasts grind their food with their teeth, and then it passes into the stomach, where it is softened and digested. On the contrary, birds of this sort first macerate and soften it in the crop, and then it is ground and comminuted in the stomach and gizzard. Birds are also careful to pick up sand, gravel, and other hard substances, not to grind their food as has been supposed, but to prevent the too violent action of the coats of the stomach against each other.

Most birds have two appendices, or blind-guts, which, in quadrupeds, are always found single. Among such birds as are thus supplied, all carnivorous fowl, and all birds of the sparrow kind, have very small and short ones; water-fowl and birds of the poultry kind, the longest of all. There is still another appendix observable in the intestines of birds, resembling a little worm, which is nothing more than the remainder of that passage by which the yolk was conveyed into the guts of the young chicken, while yet in the egg and under incubation.

The outlet of that duct which conveys the bile into the intestines is, in most birds, a great way distant from the stomach; which may arise from the danger there would be of the bile regurgitating into the stomach in their various rapid motions, as we see in men at sea; wherefore their biliary duct is so contrived, that this regurgitation cannot take place.

All birds, though they want a bladder for urine, have large kidneys and ureters, by which this secretion is made, and carried away by one common canal. "Birds," says Harvey, "as well as serpents, which have spongy lungs, make but little water, because they drink but little.—They therefore have no need of a bladder; but their urine distils down into the common canal, designed for receiving the other excrements of the body. The urine of birds differs from that of other animals: for, as there is usually in urine two parts, one more serous and liquid, the other more thick and gross, which subsides to the bottom; in birds, the last part is most abundant, and is distinguished from the rest by its white or silver colour. This part is found not only in the whole intestinal canal, but is seen also in the whole channel of the ureters, which may be distinguished from the coats of the kidneys by their whiteness. This milky substance they have in greater plenty than the more thin and serous part; and it is of a middle consistence, between limpid urine and the grosser parts of the fæces. In passing through the ureters, it resembles milk curdled or lightly condensed; and, being cast forth, easily congeals into a chalky crust."

From this simple conformation of the animal, it should seem that birds are subject to few diseases; and, in fact, they have but few. There is one, however, which they are subject to, from which quadrupeds are, in a great measure, exempt; this is the annual moulting which they suffer; for all birds whatsoever obtain a new covering of feathers once a year, and cast the old. During the moulting season they ever appear disordered; those most remarkable for their courage, then lose all their fierceness; and such as are of a weakly constitution, often expire under this natural operation. No feeding can maintain their strength; they all cease to breed at this season; that nourishment which goes to the production of the young is wholly absorbed by the demand required for supplying the nascent plumage.

This moulting-time, however, may be artificially accelerated; and those who have the management of singing-birds frequently put their secret in practice. They inclose the bird in a dark cage, where they keep it excessively warm, and throw the poor little animal into an artificial fever; this produces the

moult; his old feathers fall before their time, and a new set take place, more brilliant and beautiful than the former. They add, that it mends the bird's singing, and increases its vivacity; but it must not be concealed, that scarcely one bird in three survives the operation.

The manner in which nature performs this operation of moulting is thus: the quill, or feather, when first protruded from the skin, and come to its full size, grows harder as it grows older, and receives a kind of periosteum or skin round the shaft, by which it seems attached to the animal. In proportion as the quill grows older, its sides, or the bony part, thicken; but its whole diameter shrinks and decreases. Thus, by the thickening of its sides, all nourishment from the body becomes more sparing; and, by the decrease of its diameter, it becomes more loosely fixed in its socket, till at length it falls out. In the mean time, the rudiments of an incipient quill are beginning below. The skin forms itself into a little bag, which is fed from the body by a small vein and artery, and which every day increases in size till it is protruded. While the one end vegetates into the beard or vane of the feather, that part attached to the skin is still soft, and receives a constant supply of nourishment, which is diffused through the body of the quill by that little light substance which we always find within when we make a pen. This substance, which as yet has received no name that I know of, serves the growing quill as the umbilical artery does an infant in the womb, by supplying it with nourishment, and diffusing that nourishment over the whole frame. When, however, the quill is come to its full growth, and requires no further nourishment, the vein and artery become less and less, till at last the little opening by which they communicated with the quill becomes wholly obliterated; and the quill, thus deprived, continues in its socket for some months, till in the end it shrinks, and leaves room for a repetition of the same process of nature as before.

The moulting season commonly obtains from the end of summer to the middle of autumn. The bird continues to struggle with this malady during the winter; and Nature has kindly provided, that when there are the fewest provisions, that then the animal's appetite shall be least craving. At the beginning of spring, when food begins again to be plentiful, the animal's strength and vigour return. It is then that the abundance of provisions, aided by the mildness of the season, incite it to love, and all Nature seems teeming with life, and disposed to continue it.[1]

CHAP. II.

OF THE GENERATION, NESTLING, AND INCUBATION OF BIRDS.

The return of spring is the beginning of pleasure. Those vital spirits, which seemed

[1] Professor Blumenbach of Gottingen, in his admirable Manual of the Elements of Natural History, gives the following description of the characteristic qualities of birds. As a *summary* of all that can be said on the subject, we consider it to stand unrivalled. With regard to form, he says, all birds coincide in having *two feet, two wings, a bill, either partly or entirely horny, and a body covered with feathers.* They are distinguished by these four characters from all other animals, and constitute as it were an isolated class of beings, which does not pass into any other, and which cannot, therefore, be introduced without violence into the supposed chain or gradation of natural bodies.

Of these characters, one is peculiar to birds, viz. feathers placed in regular order (in quincunx,) in the skin, passing through a considerable quantity of fat, and thrown off and again renewed at certain seasons of the year, generally in autumn. Many, such as most water-fowl, the ptarmigan, &c., moult twice in the year, in autumn and in spring. In many species, the young birds, particularly before the first moulting, have different marks or colours of the feathers, from those which the older ones present. In many instances too, there are considerable differences depending on the sex. The feathers differ from hair in this respect, that when once cut or otherwise injured, they never, as far as is known, are restored.

The strongest feathers are in the pinions and tail: the former are called *Remiges*, the latter *Rectrices*. The pinion-feathers form, when the wing is expanded, as it were, broad fans, by which the bird is enabled to raise itself in the air and fly. Some few birds (*aves impennes*), as the penguin, &c., have scarcely any pinion-feathers, and are therefore unfit for flight. Some others also, as the cassowary, diver, &c., have not any tail-feathers.

In their internal structure, birds are distinguished by the remarkable receptacles for air dispersed through their body, and of the utmost importance in assisting their flight. They are mostly connected with the lungs, sometimes, however, only with the throat, and can be filled or emptied at pleasure. To these receptacles belong, in particular, large but delicate membranous cells, situated partly in the abdomen, partly under the wings, and elsewhere beneath the skin, and which can be filled with air through the lungs. The cavities in some of the bones, as of the shoulder, and in many cases even of the head, contribute to the same objects, to which, also, the enormous bills of the toucan and rhinoceros bird are accessary.

By these notable dispositions, birds are adapted for flight, of which the rapidity, as well as the continuance are alike remarkable. A few only, as the ostrich, the cassowary, penguin, and other *aves impennes*, are incapable of flying.

The abode of birds is nearly as various as that of mammifera. Most live in trees; others in water; very few wholly on the ground: and not a single bird under ground. The form of the foot in birds, as in mammifera, is adapted to the difference of their abodes.

Many birds change their residence at certain seasons; the greater number only in so far as that they remove a few leagues into neighbouring districts, and speedily return to their former situation: others, on the contrary,

locked up during the winter, then begin to expand; vegetables and insects supply abundance of food; and the bird, having more than a sufficiency for its own subsistence, is impelled to transfuse life, as well as to maintain it. Those warblings, which had been hushed during the colder seasons, now begin to animate the fields; every grove and bush

as swallows, the crane, the stork, &c., make long journeys in autumn over seas, and a considerable portion of the earth, and remain in warmer regions during winter, until their return in the following spring.

There is not any bird provided with teeth, but they either tear their food with the beak, or swallow it whole. In birds that live on seeds, and swallow the grains unbroken, they do not pass at once into the stomach, but are previously softened in a *crop* (*ingluvies, prolobus*) abounding with glands, and thence are gradually propelled into the stomach. The latter is in these animals extremely muscular, and so powerful, that, according to the remarkable experiments of Reaumur and others, it is able to break nuts and olive kernels, and to wear the impressions on pieces of money as smooth as paper. In addition, many birds swallow little pebbles, which also contribute to the division and subsequent digestion of their food.* Various carnivorous birds, as falcons, owls, the king-fisher, &c., are unable to digest the bones, hair, &c., of their prey, but vomit them up after each meal, in the form of a round ball.†

Among the peculiarities of the organs of sense in birds, as compared with mammifera, are the want of an external cartilaginous ear, for the purpose of collecting sounds, a deficiency, however, which is compensated for, especially in nocturnal birds of prey, by the extremely regular circular disposition of the feathers in the situation of the ear, and in many, by the super-addition of a movable valve on the external auditory passage.

Only a very few birds, viz. ducks, and some similar species, appear to possess a real sense of taste: in them the organ is the soft covering of the bill, which is supplied with exceedingly large cutaneous nerves, and is very sensible in the living animal. Accordingly it is easy to remark the manner in which ducks *probe*, as it were, the puddles in search of their food, where they cannot be guided by their sight or smell.

The voice of birds, particularly the small singing birds, is varied and agreeable; but they cannot be so correctly said to sing as to whistle, for natural singing is an exclusive privilege of man. Besides the receptacles of air already mentioned, their song is accomplished particularly by the disposition of the larynx, which in birds is not, as in mammifera and amphibia, placed wholly at the upper end of the wind-pipe, but, as it were, separated into two parts, one placed at each extremity. Parrots, ravens, starlings, bull-finches, &c. have been taught to imitate the human voice, and to speak some words; singing birds also, in captivity, readily adopt the song of others, learn tunes, and can even be made to sing in company, so that it has been possible actually to give a little concert by several bullfinches. In general, however, the song of birds in the wild state appears to be formed by practice and imitation.

Most birds pair in spring; many, however, as the cross-bill, at the coldest season of the year, after Christmas. Our domestic poultry are not confined to any particular time in this respect, but are always capable of breeding. Some birds remain in company only during the time of pairing; others, as the dove, and house swallow, constantly; others again, as the domestic fowl, and of wild birds, the ostrich, are polygamous.

The female, when impregnated, is impelled by instinct to provide for the future, and to build a nest, to which perhaps, besides the cuckoo, there are very few exceptions, such as the goatsucker. Among polygamous birds, such as the various kinds of poultry, the male has no share in this business; in those, on the contrary, which live together, as among the singing birds in particular, he also brings materials for constructing the nest, and feeds his mate during her employment.

The selection of the place in which each species forms its nest, corresponds with its wants and mode of life. Equal care is shown by each in the choice of materials for the composition of the nest.

The form of the nest is, in different instances, more or less artificial. Many birds, as snipes, the bustard, and lapwing, make merely a dry layer of brushwood, straw, &c., on the surface of the ground; others make a soft but unartificial bed in the holes of walls, rocks, or trees, as the woodpecker, jay, jackdaw, and sparrow. Many, particularly among the gallinæ, doves, and singing birds, give their nests the form of a hemisphere, or of a plate; others, as the wren, the shape of an oven; others again, as many titmice, the hawfinch, &c., that of a bag, and so forth.

When the formation of the nest is completed the mother lays her eggs, the number of which varies much in different species. Many water-birds, for instance, lay each time but one egg; most doves, two; gulls, three; ravens, four; finches, five; swallows, six to eight; partridges and quails, fourteen; and the domestic fowl, particularly when its eggs are taken away, fifty and more.‡ Many birds often lay eggs without previous impregnation, which cannot produce young, and are called wind-eggs (*ova subventanea, cynosura, zephyria, hypenemia.*)

The formation of the young animal, which in mammifera is carried on in the womb, in birds, on the contrary, is completed by the incubation of the egg after it has been deposited. The cuckoo alone does not hatch its eggs, but leaves them to the hedge-sparrow, or water-wagtail, in whose nests it lays them. On the other hand, it is known that capons, dogs, and even men, have hatched eggs.§ Chickens too, can be easily hatched by artificial means merely, from heated dung, the lamps of hatching machines, or ovens. Birds are fatigued by long continued incubation; and it is only among those which live in pairs, as doves, swallows, &c., that the male takes any part in the business. The cocks of the canary bird, linnet, goldfinch, &c., though they leave the hatching altogether to the females, supply them during its continuance with food, and in part from their own crop.

During incubation, a remarkable process is going forwards, the chick being progressively formed in the egg, and brought daily nearer and nearer to maturity. For this purpose, not only is the yolk specifically lighter than the white, but also that spot on its upper surface (the so called *cicatricula,*) in which the future chick is

* Physiologists have differed as to the object and use for which stones are thus swallowed. Many have even supposed that it proceeds from stupidity. According to my own investigation, it is an indispensible measure of assistance to digestion, by depriving the seeds swallowed of their vitality, without which they would not yield to the digestive powers.

† From a similar source arise the star-shoots, as they are called, viz. the greyish-white, gelatinous lumps, commonly with the convoluted form of intestines, found in meadows, and consisting of half-digested viscera of frogs, which have been rejected by crows, marsh and water birds. See Dr Persoon, in Voigt's *Neues Magazin*, Vol. I. Part 2. p. 56. et seq.

‡ In this case too, the laying of eggs appears to be a voluntary function, in which respect it differs remarkably from the totally involuntary parturition of mammifera.

§ Plin. L. 10. Cap. 55. "Livia Augusta, prima sua juventa Tiberio Cæsare ex Nerone gravida, cum parere virilem sexum admodum cuperet, hoc usa est puellari augurio, ovum in sinu fovendo, atque cum deponendum haberet, nutrici per sinum tradendo, ne intermitteretur tepor."

resounds with the challenge of anger, or the call of allurement. This delightful concert of the grove, which is so much admired by man, is no way studied for his amusement: it is usually the call of the male to the female; his efforts to soothe her during the times of incubation; or it is a challenge between two males, for the affections of some common favourite.

It is by this call that birds begin to pair at the approach of spring, and provide for the support of a future progeny. The loudest

placed, is lighter than the opposite side; so that in whatever position the egg is placed, the same part is always opposed to the belly of the incubating bird. The first trace of the chick is not perceptible until some time after the commencement of incubation; in the hen's egg, for instance, scarcely before the end of the first day; and at the end of the second, the remarkable spectacle of the first motions of the incomplete heart (*punctum saliens*) presents itself. At the end of the fifth day, the whole jelly-like creature may be seen to move. On the fourteenth, the feathers appear; at the commencement of the fifteenth the chick attempts to breathe; and on the nineteenth it is able to chirp.

The first form which the bird assumes in the egg differs more from that which it possesses after being hatched, than mammifera do in their first and subsequent form; we might say that the chick in the egg arrives at its more perfect form by a real metamorphosis, and this as well with respect to individual organs, (the heart for example,) as the whole form.

Among the many organs subservient to the remarkable economy of the chick during incubation, the two most important are the vascular membranes, which are most conspicuous and beautiful about the middle of the process. These are the *chorion*, which is then expanded under the shell; and the membrane of the yolk (*membrana valvulosa vitelli*,) which communicates with the intestinal canal of the young animal. The first serves instead of lungs, for the phlogistic process already mentioned; and the second for nutrition by means of the yolk, which is gradually diluted by mixing with the white.

Every species of bird has a fixed time of incubation, of different length in different cases, and capable of being accelerated or retarded according to the difference of climate, and the warmth or coldness of the weather. In the common fowl, the chick is usually able to creep out of the shell about the end of the twenty-first day.

The young birds are fed for some time by the mother with great care; and among those which live in monogamy, also by the father, principally, in the granivorous birds, with the regurgitated contents of the crop, until such time as they are feathered, and capable of providing for themselves.

Birds, in proportion to their size, and as compared with mammifera, attain a very advanced age: it is known that, even in captivity, eagles and parrots will live more than a hundred, chaffinches and goldfinches more than twenty-four years.

Birds are extremely important creatures for the economy of nature in general, although their immediate utility to mankind is infinitely less than that of mammifera. They destroy innumerable insects, and the thoughtless extirpation of some birds, supposed to be noxious, as sparrows, crows, &c., in many districts, has generally given rise to an infinitely more prejudicial multiplication of vermin. Other birds destroy larger animals, as field mice, snakes, frogs, lizards, or consume carrion. Many extirpate weeds. On the other hand, they assist the increase and propagation of animals, as well as plants. For instance, it is known that wild ducks, in their emigrations, carry impregnated spawn into remote ponds, &c., and thus stock them with fish. Many birds swallow seeds, which are subsequently expelled whole, and thus extensively dispersed, as the doves of Banda with the nutmeg. The excrement of sea-birds manures bare cliffs and coasts, so as to render them capable of producing useful plants. Many species of falcons may be taught for the chace, as well as the cormorant for taking fish. Many birds, together with their eggs, fat, &c., serve for food; the entire skins of sea-birds for the clothing of many northern nations; the feathers for stuffing beds, for writing, for various and often costly ornaments, in which respect also they form an important article of trade among many savage people, particularly the islanders of the Pacific ocean.

The injury which birds give rise to, is almost wholly confined to the destruction of useful animals and plants. The condor, the vulture, and other birds of prey, kill calves, goats, sheep, &c. The osprey, and many water-birds, are as injurious to fish and their young, as the hawk, sparrow-hawk, and magpie, to common poultry. Sparrows, and many small singing birds destroy corn, grapes, and fruit. And lastly, they assist in propagating weeds as well as serviceable plants. Among birds, no actually venomous animals are to be found.

As the general form of birds is tolerably uniform, and certain parts of their body, as the bill and feet, which are connected with their mode of life, food, &c., influence their total habit very materially, most ornithologists have grounded their classification on the differences of one or other of those parts: Kleine, for instance, on the form of the toes; Mohring, on the coverings of the legs; Brisson, on both, in combination with the nature of the bill, &c. Linnæus, in the plan of his System of Birds, also adopts several parts, in combination with, in general, a reference to the total habit; although in its practical application, he appears at times to have been forgetful; at least it is impossible to understand how parrots, humming-birds, and crows, should be placed in the same order; or why he should have placed doves and the common fowl in two separate ones, with other approximations and divisions of the same nature.

I have, therefore, allowed myself to make some deviations from the Linnean system, and endeavoured to divide the whole class among the following nine orders.

LAND BIRDS.

I. Accipitres. Birds of prey; with strong hooked beaks, mostly with short, strong, knotty feet, and large crooked sharp claws.

II. Levirostres. With short feet, and very large, thick, but mostly hollow, and therefore light, bills.—Parrots, toucans, &c.

III. Pici. With short feet; moderately long and small bills, and the tongue sometimes worm-shaped, sometimes thread-like.—The wry-neck, woodpecker, creeper, humming-bird, &c.

IV. Coraces. With short feet, and the bill moderately long, tolerably strong, and convex above.—Ravens, crows, &c.

V. Passeres. The singing birds, with swallows, &c. The feet short, the bill more or less conical, pointed, and of various length and thickness.

VI. Gallinæ. Birds with short feet, the bill somewhat convex above, and having a fleshy membrane at the base.—I have placed the doves in this order, as they are far more closely connected with the Gallinæ than the Passeres, among which Linnæus had placed them.

VII. Struthiones. Large land birds, unsuited for flying —The ostrich, cassowary, and dodo.

notes are usually from the male, while the hen seldom expresses her consent, but in a short interrupted twittering. This compact, at least for the season, holds with unbroken faith; many birds live with inviolable fidelity together for a constancy; and when one dies, the other is always seen to share the same fate soon after. We must not take our idea of the conjugal fidelity of birds from observing the poultry in our yards, whose freedom is abridged, and whose manners are totally corrupted by slavery. We must look for it in our fields and our forests, where nature continues in unadulterated simplicity; where the number of males is generally equal to that of females; and where every little animal seems prouder of his progeny, than pleased with his mate. Were it possible to compare sensations, the male of all wild birds seems as happy in the young brood as the female; and all his former caresses, all his soothing melodies, seem only aimed at that important occasion, when they are both to become parents, and to educate a progeny of their own producing. The pleasures of love appear dull in their effects, when compared to the interval immediately after the exclusion of their young. They both seem at that season transported with pleasure; every action testifies their pride, their importance, and tender solicitude.

When the business of fecundation is performed, the female then begins to lay. Such eggs as have been impregnated by the cock are prolific: and such as have not, for she lays often without any congress whatsoever, continue barren, and are only addled by incubation. Previous, however, to laying, the work of nestling becomes the common care; and this is performed with no small degree of assiduity and apparent design. It has been asserted, that birds of one kind always make their nests in the same manner, and of the same materials; but the truth is that they vary this as the materials, places, or climates, happen to differ. The red-breast, in some parts of England, makes its nest with oak leaves, where they are in greatest plenty; in other parts, with moss and hair. Some birds, that with us make a very warm nest, are less solicitous in the tropical climates, where the heat of the weather promotes the business of incubation. In general, however, every species of birds has a peculiar architecture of its own; and this is adapted to the number of eggs, the temperature of the climate, or the respective heat of the little animal's own body. Where the eggs are numerous, it is then incumbent to make the nest warm, that the animal heat may be equally diffused to them all. Thus the wren, and all the small birds, make the nest very warm; for having many eggs, it is requisite to distribute warmth to them in common: on the contrary, the plover that has but two eggs, the eagle, and the crow, are not so solicitous in this respect, as their bodies are capable of being applied to the small number upon which they sit. With regard to climate, water fowl, that with us make but a very slovenly nest, are much more exact in this particular in the colder regions of the north. They there take every precaution to make it warm; and some kinds strip the down from their breasts, to line it with greater security.

WATER BIRDS.

VIII. Grallæ. Birds found in marshes, with long feet; long, and almost cylindrical, bills, and generally a long neck.

IX. Anseres. Swimming birds with oar-like feet, a short bill covered with skin, generally serrated at the edge, and terminated at the extremity of the upper jaw by a little hook.

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1 The construction and selected situations of the nests of birds, are as remarkable as the variety of materials employed in them; the same forms, places and articles, being rarely, perhaps never, found united by the different species, which we should suppose similar necessities would direct to a uniform provision. Birds that build early in the spring seem to require warmth and shelter for their young; and the blackbird and the thrush line their nests with a plaster of loam, perfectly excluding, by these cottage-like walls, the keen icy gales of our opening year; yet should accident bereave the parents of their first hopes, they will construct another, even when summer is far advanced, upon the model of their first erection, and with the same precautions against severe weather, when all necessity for such provision has ceased, and the usual temperature of the season rather requires coolness and a free circulation of air. The house sparrow will commonly build four or five times in the year, and in a variety of situations, under the warm eaves of our houses and our sheds, the branch of the clustered fir, or the thick tall hedge that bounds our garden, &c.; in all which places, and without the least consideration of site or season, it will collect a great mass of straw and hay, and gather a profusion of feathers from the poultry-yard to line its nest This cradle for its young, whether under our tiles in March or in July, when the parent bird is panting in the common heat of the atmosphere, has the same provisions made to afford warmth to the brood; yet this is a bird that is little affected by any of the extremes of our climate. The wood pigeon and the jay, though they erect their fabrics on the tall underwood in the open air, will construct them so slightly, and with such a scanty provision of materials, that they seem scarcely adequate to support their broods, and even their eggs may almost be seen through the loosely connected materials: but the goldfinch, that inimitable spinner, the Arachne of the grove, forms its cradle of fine mosses and lichens, collected from the apple or the pear-tree, compact as a felt, lining it with the down of thistles besides, till it is as warm as any texture of the kind can be, and it becomes a model for beautiful construction. The golden-crested wren, a minute creature perfectly unmindful of any severity in our winter, and which hatches its young in June, the warmer portion of our year, yet builds its most beautiful nest with the utmost attention to warmth; and inweaving small branches of moss with the web of the spider, forms a closely compacted texture nearly an inch in thickness, lining it with such a profusion of feathers,

In general, however, every bird resorts to hatch in those climates and places where its food is found in greatest plenty; and always at that season when provisions are in the greatest abundance. The large birds, and those of the aquatic kinds, choose places as remote from man as possible, as their food is in general different from that which is cultivated by

that, sinking deep into this downy accumulation, it seems almost lost itself when sitting, and the young when hatched, appear stifled with the warmth of their bedding and the heat of their apartment; while the white-throat, the blackcap, and others, which will hatch their young nearly at the same period, or in July, require nothing of the kind. A few loose bents and goose-grass, rudely entwined, with perhaps the luxury of some scattered hairs, are perfectly sufficient for all the wants of these; yet they are birds that live only in genial temperatures, feel nothing of the icy gales that are natural to our pretty indigenous artists, but flit from sun to sun, and we might suppose would require much warmth in our climate during the season of incubation; but it is not so. The greenfinch places its nest in the hedge with little regard to concealment; its fabric is slovenly and rude, and the materials of the coarsest kinds; while the chaffinch, just above it in the elm, hides its nest with cautious care, and moulds it with the utmost attention to order, neatness, and form. One bird must have a hole in the ground; to another a crevice in the wall, or a chink in a tree, is indispensable. The bullfinch requires fine roots for its nest; the grey fly-catcher will have cobwebs for the outworks of its shed. All the parus tribe, except the individual above mentioned, select some hollow in a tree or cranny in a wall; and, sheltered as such places must be, yet will they collect abundance of feathers and warm materials for their infants' bed. Endless examples might be found of the dissimilarity of requirements in these constructions among the several associates of our groves, our hedges, and our houses; and yet the supposition cannot be entertained for a moment that they are superfluous, or not essential for some purpose with which we are unacquainted. By how many of the ordinations of Supreme Intelligence is our ignorance made manifest? Even the fabrication of the nests of these little animals exceeds our comprehension—we know none of the causes or motives of that unembodied mind that willed them thus.—*Journal of a Naturalist.*

Professor Rennie, in his volume on the Architecture of Birds, classes them according to their different styles of workmanship. He makes twelve kinds. The first division includes "mining-birds," such as the sand-martin, which scoops out its nest in the escarpment of a sand-pit or quarry: the burrowing-owl, the bee-eater, and several others belong to this class. Next come the "ground-builders," which construct a rude nest on the surface, and select a spot possessing a temperature or moisture favourable to the process of incubation. The swallow furnishes the most striking example of the operations of individuals which may appropriately be termed "mason-birds." The thrush, and some others which plaster the inside of their nests with clay, are partially connected with this class. Afterwards come birds which employs their bills as a tool for cutting out or excavating their nests. The practice of the woodpeckers in boring and chiselling a hole in which to shelter the young brood, using means analogous to those which the carpenter employs, obviously suggests the idea of classing them, with some others of similar habits, as "carpenter-birds." Those birds, the natural heat of whose body is very great, and who seldom have more than a couple of eggs each sitting, take little trouble in the construction of their nests. They are of the simplest and rudest form, and consist only of a few sticks loosely laid together. They are termed "platform-builders," this term being really descriptive of their breeding-places. The ring-dove, stock-dove, and pigeons generally, with the golden eagle, the osprey, the heron, the stork and the crane are platform-builders. Among the ruins of Persepolis the stork frequently builds its nest on the top of a perfectly flat column. The birds whose nests resemble basket-work are a large class; and the materials made use of vary from dried twigs, which form the outwork and are without flexibility, to carpenter's shavings, delicate fibrous roots, grass both coarse and fine, and horse-hair. The degree of art with which the "basket-making birds" employ their materials is not less various. Other birds weave the materials of their nests together in the neatest manner: the nests of the hedge-sparrow and wagtail afford the most familiar examples of the art of the "weaver-birds."

The art of the tailor seems more unlikely to be practised by a bird than that of the weaver. There are, however, several varieties included amongst the "tailor-birds." The orchard-starling of the United States forms the external part of its nest of a particular species of long, tough, and flexible grass, "knit or sewed," says Wilson in his 'American Ornithology,' "through and through in a thousand directions, as if actually done with a needle." He relates that an old lady of his acquaintance, to whom he was once showing this curious fabrication, asked him, in a tone between joke and earnest, whether he did not think it possible to learn these birds to darn stockings? The nest of the orchard-starling is hemispherical, three inches deep by four in breadth; the concavity scarcely two inches deep by two in diameter. The enthusiastic ornithologist whom we have quoted says, "I had the curiosity to detach one of the fibres, or stalks, of dried grass from the nest, and found it to measure thirteen inches in length; and in that distance it was thirty-four times hooked through and returned, winding round and round the nest." The tailor-bird of India is described by some naturalists as actually picking up a dead leaf, and forming a nest by sewing it with some fine fibres to the side of a living leaf. Three nests so formed are to be seen in the British Museum.* Forbes has described in his 'Oriental Memoirs,' from personal observation, the ingenuity of the tailor-bird. "It first," he says, "selects a plant with large leaves, and then gathers cotton from the shrub, spins it to a thread by means of its long bill and slender feet, and then, as with a needle, sews the leaves neatly together to conceal its nest."

The idea that man learned some of the useful arts from observation of the habits of other animate beings is not true in any extensive sense. Instinct pointed out to the class termed "felt-making birds" the suitability of the materials which they select for weaving or uniting into a continuous mass. The nest of the capocier, an American bird, which was examined by Wilson, is described by him as so "neatly worked and felted together, that it might have been taken for a piece of fine cloth a little worn." Man was long before he employed the same materials in the manufacture of cloth, and it is only by the aid of the microscope that he has been able to discover the cause which adapts them for this purpose, and the true character of their felting properties. The "felt-making birds" availed themselves of these properties from the creation.

The nests of the esculent swallow of Java are an article of commercial importance, the nests themselves being edible, and considered as a luxury and restorative. These nests are supposed to be composed of oceanic vegetables, whose principle being highly gelatinous, and cemented with the salivary gluten of the bird, form a sort of edi-

human labour. Some birds, which have only the serpent to fear, build their nests depending from the end of a small bough, and form the entrance from below; being thus secured either from the serpent or the monkey tribes. But all the little birds which live upon fruits and corn, and that are too often unwelcome intruders upon the fruits of human industry, in making their nests, use every precaution to conceal them from man. On the other hand, the great birds remote from human society, use every precaution to render theirs inaccessible to wild beasts or vermin.

Nothing can exceed the patience of birds while hatching; neither the calls of hunger, nor the near approach of danger, can drive them from the nest. They are often fat upon beginning to sit, yet before incubation is over, the female is usually wasted to skin and bone. Ravens and crows, while the females are sitting, take care to provide them with food; and this in great abundance. But it is different with most of the smaller kinds; during the whole time, the male sits near his mate upon some tree, and soothes her by his singing; and often when she is tired takes her place and patiently continues upon the nest till she returns. Sometimes, however, the eggs acquire a degree of heat too much for the purposes of hatching; in such cases, the hen leaves them to cool a little, and then returns to sit with her usual perseverance and pleasure.

So great is the power of instinct, in animals of this class, that they seem driven from one appetite to another, and continue almost passive under its influence. Reason we cannot call it, since the first dictates of that principle would be self-preservation:—"Take a brute," says Addison, "out of his instinct, and you find him wholly deprived of understanding. With what caution," continues he, "does the hen provide herself with a nest in places unfrequented, and free from noise and disturbance! When she has laid her eggs in such a manner that she can cover them, what care does she take in turning them frequently, that all parts may partake of the vital warmth! When she leaves them, to provide for her necessary sustenance, how punctually does she return before they have time to cool, and become incapable of producing an animal! In the summer you see her giving herself greater freedoms, and quitting her care for above two hours together: but in winter, when the rigour of the season would chill the principles of life, and destroy the young one, she grows more assiduous in her attendance, and stays away but half the time. When the birth approaches, with how much nicety and attention does she help the chick to break the prison! not to take notice of her covering it from the injuries of the weather, providing it with proper nourishment, and teaching it to help itself; nor to mention her forsaking the nest, if, after the usual time of reckoning, the young one does not make its appearance. A chemical operation could not be followed with greater art or diligence than is seen in the hatching a chick, though there are many birds that show an infinitely greater sagacity: yet at the same time the hen, that has all this seeming ingenuity, (which is indeed absolutely necessary for the propagation of the species,) considered in other respects, is without the least glimmerings of thought or common sense: she mistakes a piece of chalk for an egg, and sits upon it in the same manner; she is insensible of any increase or diminution in the number of those she lays; she does not distinguish between her own, and those of another species; and when the birth appears of never so different a bird, will cherish it for her own. A hen, followed by a brood of ducks, shall stand affrighted at the edge of the pond trembling for the fate of her young, which she sees venturing into so dangerous an element. As the different principle which acts in these different animals cannot be termed reason, so when we call it instinct, we mean something we have no knowledge of. It appears to me the immediate direction of Providence; and such an operation of the Supreme Being, as that which determines all the portions of matter to their proper centres."

The production of the young, as was said, seems to be the great era of a bird's happiness. Nothing can at that time exceed its spirit and industry: the most timid becomes courageous in the defence of its young. Birds of the rapacious kind, at this season, become more than usually fierce and active. They carry their prey, yet throbbing with life, to the nest, and early accustom their young to habits of slaughter and cruelty. Nor are those of milder natures less busily employed; the little birds then discontinue their singing, taken up with more important pursuits of common subsistence.[1]

ble paste. Other birds whose nests are tempered by cement produced by a glutinous matter which the bird secretes and mixes with saliva, are, with the Java swallow, classed as "cementers." The "dome-builders" include several of our most familiar birds—as the magpie, the wren, the sparrow. Lastly come birds which build no nest at all, but deposit their eggs in the nest of some other bird.

[1] There cannot be any question of the immense number of insects required by birds during the breeding season. It is stated by Bingly, that a pair of small American birds, conjectured to be the house-wren, were observed to leave the nest and return with insects from forty to sixty times in an hour, and that in one particular hour, they carried food no fewer than seventy-one times. In this

While the young are yet unfledged, and continue in the nest, the old ones take care to provide them with a regular supply; and, lest one should take all nourishment from the rest, they feed each of the young in their turn. If they perceive that man has been busy with their nest, or has handled the little ones, they abandon the place by night, and provide their brood a more secure, though less commodious retreat. When the whole family is completely plumed, and capable of avoiding danger by flight; they are then led forth when the weather is fine, and taught the paternal art of providing for their subsistence. They are led to the places where their food lies; they are shown the method of discovering or carrying it away; and then led back to the nest, for a day or two longer. At length, when they are completely qualified to shift for themselves, the old ones take them abroad, and leading them to the accustomed places, forsake them for the last time; and all future connection is ever at an end.

Those birds which are hatched and sent out earliest in the season are the most strong and vigorous; those, on the other hand, that have been delayed till the midst of summer, are more feeble and tender, and sometimes incapable of sustaining the rigours of the ensuing winter. Birds themselves seem sensible of this difference, and endeavour to produce early in the spring. If, however, their efforts are obstructed by having their nests robbed, or some similar accident, they still persevere in their efforts for a progeny; and it often happens that some are thus retarded till the midst of winter. What number of eggs any bird can lay in the course of a season is not ascertained; but this is true, that such as would have laid but two or three at the most, if their nests be robbed, or their eggs stolen, will lay above ten or twelve. A common hen, if moderately fed, will lay above a hundred from the beginning of spring to the latter end of autumn. In general, however, it obtains, that the smallest and weakest animals are the most prolific, while the strong and rapacious are abridged by sterility. Thus, such kinds as are easily destroyed, are as readily repaired; and Nature, where she has denied the

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business they were engaged during the greatest part of the day. Allowing twelve hours to be thus occupied, a single pair of these birds would destroy at least six hundred insects in the course of one day; on the supposition that the two birds took only a single insect each time. But it is highly probable that they often took more.

Looking at the matter in this point of view, the destruction of insectivorous birds has in some cases been considered as productive of serious mischief. One striking instance we distinctly recollect, though we cannot at this moment turn to the book in which it is recorded. The numbers of the crows or rooks of North America were in consequence of state rewards for their destruction, so much diminished, and the increase of insects so great, as to induce the state to announce a counter reward for the protection of the crows. Such rewards are common in America; and from a document given by Wilson, respecting a proposal made in Delaware "for banishing or destroying the crows," it appears that the money thus expended sometimes amounts to no inconsiderable sum. The document concludes by saying, "the sum of five hundred dollars being thus required, the committee beg leave to address the farmers and others of Newcastle county and elsewhere on the subject."

From its sometimes eating grain and other seeds, "the rook," says Selby, "has erroneously been viewed in the light of an enemy by most husbandmen; and in several districts attempts have been made either to banish it, or to extirpate the breed. But wherever this measure has been carried into effect, the most serious injury to the corn and other crops has invariably followed, from the unchecked devastations of the grub and caterpillar. As experience is the sure test of utility, a change of conduct has in consequence been partially adopted; and some farmers now find the encouragement of the breed of rooks to be greatly to their interest, in freeing their lands from the grub of the cockchafer, an insect very abundant in many of the southern counties. In Northumberland I have witnessed its usefulness in feeding on the larvæ of the insect commonly known by the name of Harry Long-legs, which is particularly destructive to the roots of grain and young clovers."

It has on similar grounds been contended, that the great number of birds caught by bird-catchers, particularly in the vicinity of London, has been productive of much injury to gardens and orchards. So serious has this evil appeared to some, that it has even been proposed to have an act of parliament prohibiting bird-catchers from exercising their art within twenty miles of the metropolis; and also prohibiting wild birds of any kind from being shot or otherwise caught or destroyed within this distance, under certain penalties. It is very clear, however, that such an act could never be carried; and though it *might* be advantageous to gardens, orchards, and farms, yet the attacks which the same birds make on fruit would probably be an equivalent counterbalance.

In the case of swallows, on the other hand, it has been well remarked by an excellent naturalist (the Rev. W. T. Bree,) that they are to us quite inoffensive, while "the beneficial services they perform for us, by clearing the air of innumerable insects, ought to render them sacred and secure them from our molestation. Without their friendly aid the atmosphere we live in, would scarcely be habitable by man: they feed entirely on insects, which if not kept under by their means, would swarm and torment us like another Egyptian plague. The immense quantity of flies destroyed in a short space of time by one individual bird is scarcely to be credited by those who have not had actual experience of the fact." He goes on to illustrate this from a swift, which was shot. "It was in the breeding season when the young were hatched; at which time the parent birds, it is well known, are in the habit of making little excursions into the country to a considerable distance from their breeding places, for the purpose of collecting flies which they bring home to their infant progeny. On picking up my hapless and ill-gotten prey, I observed a number of flies, some mutilated, others scarcely injured, crawling out of the bird's mouth; the throat and pouch seemed absolutely stuffed with them, and an incredible number was at length disgorged. I am sure I speak within compass when I state that there was a mass of flies, just caught by this single swift, larger than when pressed close, could conveniently be contained in the bowl of an ordinary table-spoon."—*Habits of Birds. Library of Entertaining Knowledge.*

power of resistance, has compensated by the fertility attending procreation.

Birds in general, though they have so much to fear from man and each other, are seldom scared away from their usual haunts. Although they be so perfectly formed for a wandering life, and are supplied with powers to satisfy all their appetites, though ever so remote from the object, though they are so well fitted for changing place with ease and rapidity, yet the greatest number remain contented in the districts where they have been bred, and by no means exert their desires in proportion to their endowments. The rook, if undisturbed, never desires to leave his native grove; the black-bird still frequents its accustomed hedge; and the red-breast, though seemingly mild, claims a certain district, from which he seldom moves, but drives out every one of the same species from thence without pity. They are excited to migration by no other motives but those of fear, climate, or hunger. It must be from one of these powerful motives that the birds, which are called birds of passage, every year forsake us for some time, and make their regular and expected returns.

Nothing has more employed the curiosity of mankind than these annual emigrations; and yet few subjects continue so much involved in darkness. It is generally believed, that the cause of their retreat from these parts of Europe, is either a scarcity of food at certain seasons, or the want of a secure asylum from the persecution of man, during the time of courtship and bringing up their young. Thus the starling, in Sweden, at the approach of winter, finding subsistence no longer in that kingdom, descends every year into Germany; and the hen chaffinches of the same country are seen every year to fly through Holland in large flocks, to pass their winter in a milder climate. Others, with a more daring spirit, prepare for journeys that might intimidate even human perseverance. Thus the quails, in spring, forsake the burning heats of Africa for the milder sun of Europe; and, when they have past the summer with us, steer their flight back to enjoy in Egypt the temperate air, which then begins to be delightful. This, with them, seems a preconcerted undertaking. They unite together in some open place, for some days before their departure, and, by an odd kind of chattering, seem to debate on the method to proceed. When their plan is resolved upon, they all take flight together, and often appear in such numbers, that to mariners at sea they seem like a cloud that rests upon the horizon. The boldest, strongest, and by far the greatest number, make good their intention; but many there are, who, not well apprised of their own force for the undertaking, grow weary on the way, and, quite spent by the fatigues of their flight, drop down into the sea, and sometimes upon deck, thus becoming an easy prey to the mariner.

Of the vast quantity of water-fowl, that frequent our shores, it is amazing to reflect how few are known to breed here. The cause that principally urges them to leave this country, seems to be not merely the want of food, but the desire of a secure retreat. Our country is too populous for birds so shy and timid as the greatest number of these are. When great part of our island was a mere waste, an uncultivated tract of woods and marshes, many species of birds which now migrate remained with us throughout the year. The great heron and the crane, that have now forsaken this country, in former times bred familiarly in our marshes, and seemed to animate our fens. Their nests, like those of most cloven-footed water-fowl, were built on the ground, and exposed to every invader. But as rural economy increased, these animals were more and more disturbed. Before they had little to fear, as the surrounding marsh defended them from all the carnivorous quadrupeds, and their own strength from birds of prey; but upon the intrusion of man, and by a long series of alarms, they have at length been obliged to seek, during the summer, some lonely habitation, at a safe distance from every destroyer.

Of the numerous tribes of the duck kind, we know of no more than five that breed here; the tame swan, the tame goose, the sheldrake, the eider duck, and a few of the wild ducks. The rest contribute to form that amazing multitude of water fowl which annually repair to the dreary lakes and deserts of Lapland from the more southern countries of Europe. In those extensive and solitary retreats, they perform the duties of incubation and nutrition in full security. There are few of this kind that may not be traced to the northern deserts, to countries of lakes, rivers, swamps, and mountains, covered with thick and gloomy forests, that afford shelter during summer to the timid animals, who live there in undisturbed security. In those regions, from the thickness of the forests, the ground remains moist and penetrable during the summer season; the woodcock, the snipe, and other slender-billed birds, can there feed at ease; while the web-footed birds find more than sufficient plenty of food from the number of insects, which swarm there to an incredible degree. The days there are long; and the beautiful meteorous nights afford them every opportunity of collecting so minute a food, which is probably of all others the most grateful. We are not to be astonished, therefore, at the amazing numbers of fowl that descend from these regions at the approach of winter;

numbers to which the army of Xerxes was but trifling in comparison; and which Linnæus has observed for eight whole days and nights to cover the surface of the river Calix.

This migration from the north usually begins in September, when they quit their retreats, and disperse themselves over all the southern parts of Europe. It is not unpleasing to observe the order of their flight; they generally range themselves in a long line, or they sometimes make their march angularly, two lines uniting in the centre like the letter V reversed. The bird which leads at the point seems to cleave the air, to facilitate the passage for those which are to follow. When fatigued with this laborious station, it falls back into one of the wings of the file, while another takes its place. With us they make their appearance about the beginning of October, circulate first round our shores, and, when compelled by severe frost, betake themselves to our lakes and rivers. Some, indeed, of the web-footed fowl, of hardier constitutions than the rest, abide the rigours of their northern climate the whole winter; but when the cold reigns there with more than usual severity, they are obliged to seek for more southern skies. They then repair with the rest for shelter to these kingdoms; so that the diver, the wild swan, and the swallow-tailed sheldrake, visit our coasts but seldom, and that only when compelled by the severity of their winters at home.[1]

[1] The facts which are known relative to the migration of birds are very curious, and yet leave a vast field for interesting observation. Some birds regularly return, after a certain absence, not only to the same country, but to the same spot where they built their nests before, or where they were bred. Many storks, which become half tame in Germany, have been marked, and found to return regularly to their old nests, built on a wheel, which the peasants of that country, particularly in the north, place, for that purpose, on the corner of the roofs of their houses. The same is related of swallows, and other birds of passage. Other birds do not return to a particular country, but travel, according to circumstances, from one to another. Among the former are some which remain in the country of their nativity only as long as is necessary to breed and bring up their young; others are absent but for a very short time. The loriot remains but three months in the middle regions of Europe, whilst the lark is absent but for a very short time. Mr Brehm, a German, has collected many interesting facts respecting the birds of passage. Generally speaking, they are determined as to the place where they build their nests, by the means of subsistence which they find, as, for instance, the grosbeak, goldfinch, pigeons, cranes, landrails, several species of herons, woodcock, geese, ducks. In 1819, the fruit of the pine-tree being scarce in the north of Europe, whilst it was very abundant in the central parts, large numbers of the crossbill, which chiefly lives upon this food, were found in the latter regions.

Hunters, and other people living much in the open air, know that certain birds do not migrate, except on the approach of a severe winter. How are these birds led to migrate at such seasons? The general and easy answer is, by instinct. But what is instinct? Certainly we cannot mean, by this term, a constant direct interposition of Providence, which drives the birds away because a severe winter is coming on. Instinct, whatever it may be, must be guided by general laws. In what way, however, the birds are led to guard against the severity of the approaching season, whether by peculiar sensibility to the causes from which its severity will proceed, or in other ways, we know not. It has been maintained that much of the conduct of animals necessarily implies reflection. The vicissitudes of the atmosphere, on the arrival of the migrating time, have also a great influence upon them. Most birds perform their migration during the night; some species, however, by day. Others stop not, either by day or night. To the class which fly by day belong the birds of prey which obtain their food by day—the crow, pie, titmouse, wren, woodpecker, chaffinch, goldfinch, lark, swallow, and some others. Those which travel by night are the owl, blackbird, &c., and a great number of aquatic birds. Those which stop not, day or night, are the heron, wagtail, yellow-hammer, plover, stork, crane, wildgoose, swan. It is very remarkable, that individuals of those species which travel day and night, and which, by some cause, are prevented from migrating, remain, during all the time of the migration of their species, awake, and only occupy themselves with taking food. These birds like particularly to travel in bright moonlight.

Many birds obtain their food on the wing. The swallows, traversing the sea, catch insects, and fishing birds catch fish, whilst they continue their journey. If the titmouse, wren, woodpecker, and pie, rest for some time on the branches of trees, they soon resume their flight, after having fed. Those birds which habitually alight on spots where they find nourishment in abundance, never remain longer than two days in succession, if nothing opposes the continuance of their flight. It is a curious fact that at these times many birds utter cries such as they are never heard to make at any other time. Unless obliged by fogs to keep near the ground, birds generally fly very high during their migration. Of all migrating birds, the cranes are perhaps the most remarkable. They seem to be most endowed with foresight. They call each other by certain cries, several days before they depart, assemble, and make a great noise, as if consulting; after which, they range themselves in two lines, forming an angle, at the vertex of which is the leader, who appears to exercise authority and give orders, for instance, to form a circle in a tempest, or to be watchful if eagles approach, &c.; he also gives the sign to descend and take food. If he is tired, he places himself at the end of the line, and the bird next behind him takes his place. They utter, during the night, more piercing cries than during the day, and it seems as if orders and answers were given. Wild geese and ducks travel in a similar way. To enable birds to fly with ease, and to continue long on the wing, they must fly against the wind, in which respect flying is directly opposite to sailing. Sportsmen are well acquainted with this fact. If the wind is unfavourable for a time, the migration is retarded, yet never entirely given up, only the birds arrive much leaner, being fatigued by their efforts. It is astonishing how tender birds, as the linget, for instance, set out from the extremity of Norway, and brave a long journey even over the ocean. The quails, which are heavy in their flight, wait on the shores of the Mediterranean, often a long time, for a favourable wind, of which they immediately avail themselves, halting on all the islands. If the wind suddenly changes, many are drowned in the sea.

It has been often a subject of astonishment, how animals, to all appearance so dull and irrational, should perform such long journeys, should know whither to steer, and when to

set out upon such a great undertaking. It is probable that the same instinct which governs all their other actions operates also here. They rather follow the weather than the country; they steer only from colder or warmer climates into those of an opposite nature; and finding the variations of the air as they proceed in their favour, go on till they find land to repose on. It cannot be supposed that they have any memory of the country where they might have spent a former winter; it cannot be supposed that they see the country to which they travel, from their height in the air; since, though they mounted for miles, the convexity of the globe would intercept their view; it must therefore only be, that they go on as they continue to perceive the atmosphere more suitable to their present wants and dispositions.

All this seems to be pretty plain: but there is a circumstance attending the migration of swallows which wraps this subject in great obscurity. It is agreed on all hands, that they are seen in migrating into warmer climates, and that in amazing numbers, at the approach of the European winter. Their return into Europe is also as well attested about the beginning of summer; but we have another account, which serves to prove that numbers of them continue torpid here during the winter, and like bats, make their retreat into old walls, the hollow of trees, or even sink into the deepest lakes, and find security for the winter season by remaining there in clusters at the bottom. However this latter circumstance may be, their retreat into old walls is too well authenticated to remain a doubt at present. The difficulty, therefore, is to account for this difference in these animals thus variously preparing to encounter the winter. It was supposed that in some of them the blood might lose its motion by the cold, and that thus they were rendered torpid by the severity of the season; but Mr Buffon having placed many of this tribe in an ice-house, found that the same cold by which their blood was congealed was fatal to the animal; it remains, therefore, a doubt to this hour, whether there may not be a species of swallows to all external appearance like the rest, but differently formed within, so as to fit them for a state of insensibility during the winter here. It was suggested, indeed, that the swallows found thus torpid, were such only as were too weak to undertake the migration, or were hatched too late to join the general convoy; but it was upon these that Mr Buffon tried his experiment; it was these that died under the operation.

Thus there are some birds which by migrating make an habitation of every part of the earth; but in general every climate has birds peculiar to itself. The feathered inhabitants of the temperate zone are but little remarkable for the beauty of their plumage; but then the smaller kinds make up for this defect by the melody of their voices. The birds of the torrid zone are very bright and vivid in their colours; but they have screaming voices, or are totally silent. The frigid zone, on the other hand, where the seas abound with fish, are stocked with birds of the aquatic kind, in much greater plenty than in Europe; and these are generally clothed with a warmer coat of feathers; or they have large quantities of fat lying underneath the skin, which serves to defend them from the rigours of the climate.

In all countries, however, birds are a more long-lived class of animals than the quadrupeds or insects of the same climate. The life of man himself is but short, when compared to what some of them enjoy. It is said that swans have been known to live three hundred years; geese are often seen to live fourscore; while linnets and other little birds, though imprisoned in cages, are often found to reach fourteen or fifteen. How birds, whose age of perfection is much more early than that of quadrupeds, should yet live comparatively so much longer, is not easily to be accounted for: perhaps, as their bones are lighter, and more porous, than those of quadrupeds, there are fewer obstructions in the animal machine; and Nature, thus finding more room for the operations of life, is carried on to a greater extent.

White has remarked, in his Natural History of Selborne, that little stress may be laid on the difficulty and hazard that birds must run in their migrations, by reason of vast oceans, cross winds, &c., because, says he, if we reflect, a bird may travel from England to the equator without launching out or exposing itself to boundless seas, and that by crossing the British Channel at Dover and the Mediterranean at Gibraltar; thus selecting the narrowest points of passage. It is, however, certain that migrating birds in their flight are often subject both to disasters and considerable fatigue. This indeed has been instanced by the settling of birds in an exhausted state on the rigging and decks of vessels at sea. Certain birds, as the moorhen, rail, &c., being unable to fly for any considerable distance, travel partly on foot. Some even (as the great auk or penguin, diver, and guillemot) migrate by water. Ornithologists have observed, that, in Europe, birds migrate in autumn to the south-west, and in spring towards the north-east; yet the courses of rivers and chains of mountains exercise considerable influence on the direction of their flight. It is remarkable, also, that the young of certain species do not make the same journey as the old birds; they go more to the south, so that it is very common to find, in the south of Europe, only the young birds of a certain species, whilst the older ones remain more to the north. In other species, the females go farther south. It was formerly believed that the birds of the tropical regions never migrate, and that they never pass the line; but Humboldt has shown that this is not the case. He observed, moreover, that the migration there took place with the periodical rise of rivers.

All birds in general are less than quadrupeds; that is, the greatest of one class far surpass the greatest of the other in magnitude. The ostrich, which is the greatest of birds, bears no proportion to the elephant; and the smallest humming-bird, which is the least of the class, is still far more minute than the mouse. In these the extremities of nature are plainly discernible; and in forming them she appears to have been doubtful in her operations: the ostrich, seemingly covered with hair, and incapable of flight, making near approaches to the quadruped class; while the humming bird, of the size of an humble-bee, and with a fluttering motion, seems nearly allied to the insect.

These extremities of this class are rather objects of human curiosity than utility: it is the middle order of birds which man has taken care to propagate and maintain. Of those which he has taken under his protection, and which administer to his pleasures or necessities, the greatest number seem creatures of his formation. The variety of climate to which he consigns them, the food with which he supplies them, and the purposes for which he employs them, produce amazing varieties, both in their colours, shape, magnitude, and the taste of their flesh. Wild birds are, for the most part, of the same magnitude and shape; they still keep the prints of primeval nature strong upon them, except in a few; they generally maintain their very colour: but it is otherwise with domestic animals; they change at the will of man—of the tame pigeon, for instance, it is said they can be bred to a feather.

As we are thus capable of influencing their form and colour, so also is it frequent to see equal instances of our influencing their habitudes, appetites, and passions. The cock, for instance, is artificially formed into that courage and activity which he is seen to possess; and many birds testify a strong attachment to the hand that feeds them; how far they are capable of instruction, is manifest to those that have the care of hawks. But a still more surprising instance of this was seen some time ago in London: a canary bird was taught to pick up the letters of the alphabet, at the word of command, so as to spell any person's name in company; and this the little animal did by motions from its master, which were imperceptible to every other spectator. Upon the whole, however, they are inferior to quadrupeds in docility; and seem more mechanically impelled by all the power of instinct.

CHAP. III.

OF THE DIVISION OF BIRDS.

Though birds are fitted for sporting in the air, yet as they find their food upon the surface of the earth, there seems a variety equal to the different aliments with which it tends to supply them. The flat and burning desert, the rocky cliff, the extensive fen, the stormy ocean, as well as the pleasing landscape, have all their peculiar inhabitants. The most obvious distinction therefore of birds, is into those that live by land and those that live by water; or, in other words, into *land birds*, and *water fowl*.

It is no difficult matter to distinguish land from water fowl, by the legs and toes. All land birds have their toes divided without any membrane or web between them; and their legs and feet serve them for the purposes of running, grasping, or climbing. On the other hand, water fowl have their legs and feet formed for the purposes of wading in water, or swimming on its surface. In those that wade, the legs are usually long and naked; in those that swim, the toes are webbed together, as we see in the feet of a goose, which serve, like oars, to drive them forward with greater velocity. The formation therefore, of land and water fowl, is as distinct as their habits; and Nature herself seems to offer us this obvious distribution, in methodizing animals of the feathered creation.

However, a distinction so comprehensive goes but a short way in illustrating the different tribes of so numerous a class. The number of birds already known, amounts to above eight hundred;[1] and every person who turns his mind to these kinds of pursuits, is every day adding to the catalogue. It is not enough, therefore, to be able to distinguish a land from a water fowl; much more is still required—to be able to distinguish the different kinds of birds from each other; and even the varieties in the same kind, when they happen to offer. This certainly is a work of great difficulty; and perhaps the attainment will not repay the labour. The sensible part of mankind will not withdraw all their attention from more important pursuits, to give it entirely up to what promises to repay them only with a very confined species of amusement. In my distribution of birds, therefore, I will follow Linnæus in the first sketch of his system; and then leave him, to follow the most natural distinctions, in enumerating the

[1] Since Goldsmith's time, nearly three thousand species of birds have been ascertained, and many of the species have several varieties.

different kinds that admit of a history, or require a description.

Linnæus divides all birds into six classes; namely, into birds of the *rapacious kind*, birds of the *pie kind*, birds of the *poultry kind*, birds of the *sparrow kind*, birds of the *duck kind*, and birds of the *crane kind*. The four first comprehend the various kinds of land birds; the two last, those that belong to the water.

Birds of the *rapacious kind* constitute that class of carnivorous fowl that live by rapine. He distinguishes them by their beak, which is hooked, strong, and notched at the point; by their legs, which are short and muscular, and made for the purposes of tearing; by their toes, which are strong and knobbed; and their talons, which are sharp and crooked; by the make of their body, which is muscular; and their flesh, which is impure: nor are they less known by their food, which consists entirely of flesh; their stomach, which is membranous; and their manners, which are fierce and cruel.

Birds of the *pie kind* have the bill differing from the former: as in those it resembles a hook, destined for tearing to pieces; in these it resembles a wedge, fitted for the purpose of cleaving. Their legs are formed short and strong, for walking; their body is slender and impure, and their food miscellaneous. They nestle in trees; and the male feeds the female during the time of incubation.

Birds of the *poultry kind* have the bill a little convex, for the purposes of gathering their food. The upper chap hangs over the lower; their bodies are fat and muscular, and their flesh white and pure. They live upon grain, which is moistened in the crop. They make their nest on the ground, without art; they lay many eggs, and use promiscuous venery.

Birds of the *sparrow kind* comprehend all that beautiful and vocal class that adorn our fields and groves, and gratify every sense in its turn. Their bills may be compared to a forceps that catches hold; their legs are formed for hopping along; their bodies are tender; pure in such as feed upon grain, impure in such as live upon insects. They live chiefly in trees; their nests are artificially made, and their amours are observed with connubial fidelity.

Birds of the *duck kind* use their bill as a kind of strainer to their food; it is smooth, covered with a skin, and nervous at the point. Their legs are short, and their feet formed for swimming, the toes being webbed together. Their body is fat, inclined to rancidity. They live in waters, and chiefly build their nests upon land.

With respect to the order of birds that belong to the waters, those of the *crane kind* have the bill formed for the purposes of searching and examining the bottom of pools; their legs are long, and formed for wading; their toes are not webbed; their thighs are half naked; their body is slender, and covered with a very thin skin; their tail is short, and their flesh savoury. They live in lakes upon animals, and they chiefly build their nests upon the ground.

Such is the division of Linnæus with respect to this class of animals; and, at first sight, it appears natural and comprehensive. But we must not be deceived by appearances: the student, who should imagine he was making a progress in the history of Nature, while he was only thus making arbitrary distributions, would be very much mistaken. Should he come to enter deeper into this naturalist's plan, he would find birds the most unlike in nature thrown together into the same class; and find animals joined, that entirely differ in climate, in habitudes, in manners, in shape, colouring, and size. In such a distribution, for instance, he would find the humming bird and the raven, the rail and the ostrich, joined in the same family. If, when he asked what sort of a creature was the humming-bird, he were told that it was in the same class with the carrion-crow, would he not think himself imposed upon? In such a case the only way to form any idea of the animal whose history he is desirous to know, is to see it; and that curiosity very few have an opportunity of gratifying. The number of birds is so great, that it might exhaust the patience not only of the writer, but the reader, to examine them all: in the present confined undertaking it would certainly be impossible. I will, therefore, now attach myself to a more natural method; and still keeping the general division of Linnæus before me, enter into some description of the most noted, or the most worth knowing.

Under one or other class, as I shall treat them, the reader will probably find all the species, and all the varieties that demand his curiosity. When the leader of any tribe is described, and its history known, it will give a very tolerable idea of all the species contained under it. It is true, the reader will not thus have his knowledge ranged under such precise distinctions; nor can he be able to say with such fluency, that the rail is of the ostrich class; but what is much more material, he will have a tolerable history of the bird he desires to know, or at least of that which most resembles it in nature.

However, it may be proper to apprize the reader, that he will not here find his curiosity satisfied, as in the former volumes, where we often took Mr Buffon for our guide. Those who have hitherto written the natural history

of birds, have in general been contented with telling their names, or describing their toes or their plumage. It must often, therefore, happen, that instead of giving the history of a bird, we must be content to entertain the reader with merely its description. I will, therefore, divide the following history of birds, with Linnæus, into six parts; in the first of which I will give such as Brisson has ranged among the rapacious birds; next those of the pie kind; and thus go on through the succeeding classes, till I finish with those of the duck kind. But before I enter upon a systematic detail, I will beg leave to give the history of three or four birds, that do not well range in any system. These, from their great size, are sufficiently distinguishable from the rest; and from their incapacity of flying, lead a life a good deal differing from the rest of the feathered creation. The birds I mean are the Ostrich, the Cassowary, the Emu, the Dodo, and the Solitaire.

CHAP. IV.

THE OSTRICH.

(*See Plate XV. fig.* 38.)

In beginning with the feathered tribe, the first animal that offers seems to unite the class of quadrupeds and of birds in itself. While it has the general outline and properties of a bird, yet it retains many of the marks of the quadruped. In appearance the ostrich resembles the camel, and is almost as tall; it is covered with a plumage that resembles hair much more nearly than feathers, and its internal parts bear as near a similitude to those of the quadruped, as of the bird creation. It may be considered, therefore, as an animal made to fill up that chasm in nature which separates one class of beings from another.

The ostrich is the largest of all birds. Travellers affirm, that they are seen as tall as a man on horseback; and even some of those that have been brought into England were above seven feet high. The head and bill somewhat resemble those of a duck; and the neck may be likened to that of a swan, but that it is much longer; the legs and thighs resemble those of a hen; though the whole appearance bears a strong resemblance to that of a camel. But to be more particular: it is usually seven feet high from the top of the head to the ground; but from the back it is only four; so that the head and neck are above three feet long. From the top of the head to the rump, when the neck is stretched out in a right line, it is six feet long, and the tail is about a foot more. One of the wings, without the feathers, is a foot and a half; and being stretched out, with the feathers, is three feet.

The plumage is much alike in all; that is, generally black and white; though some of them are said to be gray. The greatest feathers are at the extremities of the wings and tail, and the largest are generally white. The next row is black and white; and of the small feathers, on the back and belly, some are white and others black. There are no feathers on the sides, nor yet on the thighs, nor under the wings. The lower part of the neck, about half way, is covered with still smaller feathers than those on the belly and back; and those, like the former, also are of different colours.

All these feathers are of the same kind, and peculiar to the ostrich; for other birds have several sorts, some of which are soft and downy, and others hard and strong. Ostrich feathers are almost all as soft as down, being utterly unfit to serve the animal for flying, and still less adapted to be a proper defence against external injury. The feathers of other birds have the webs broader on one side than the other, but those of the ostrich have their shaft exactly in the middle. The upper part of the head and neck is covered with a very fine, clear, white hair, that shines like the bristles of a hog; and in some places there are small tufts of it, consisting of about twelve hairs, which grow from a single shaft about the thickness of a pin.

At the end of each wing there is a kind of spur, almost like the quill of a porcupine. It is an inch long, being hollow, and of a horny substance. There are two of these on each wing, the largest of which is at the extremity of the bone of the wing, and the other a foot lower. The neck seems to be more slender in proportion to that of other birds, from its not being furnished with feathers. The skin in this part is of a livid flesh-colour, which some improperly would have to be blue. The bill is short and pointed, and two inches and a half at the beginning. The external form of the eye is like that of man, the upper eyelid being adorned with eye-lashes, which are longer than those on the lid below. The tongue is small, very short, and composed of cartilages, ligaments, and membranes, intermixed with fleshy fibres. In some it is about an inch long, and very thick at the bottom. In others it is but half an inch, being a little forked at the end.

The thighs are very fleshy and large, being covered with a white skin, inclining to redness, and wrinkled in the manner of a net, whose meshes will admit the end of a finger. Some have very small feathers here and there

on the thighs; and others again have neither feathers nor wrinkles. What are called the legs of birds, in this are covered before with large scales. The end of the foot is cloven, and has two very large toes, which, like the leg, are covered with scales. These toes are of unequal sizes. The largest, which is on the inside, is seven inches long, including the claw, which is near three-fourths of an inch in length, and almost as broad. The other toe is but four inches long, and is without a claw.

The internal parts of this animal are formed with no less surprising peculiarity. At the top of the breast, under the skin, the fat is two inches thick; and on the fore part of the belly it is as hard as suet, and about two inches and a half thick in some places. It has two distinct stomachs. The first, which is lowermost, in its natural situation somewhat resembles the crop in other birds; but it is considerably larger than the other stomach, and is furnished with strong muscular fibres, as well circular as longitudinal. The second stomach, or gizzard, has outwardly the shape of the stomach of a man; and, upon opening, is always found filled with a variety of discordant substances; hay, grass, barley, beans, bones, and stones, some of which exceed in size a pullet's egg. The kidneys are eight inches long and two broad, and differ from those of other birds in not being divided into lobes. The heart and lungs are separated by a midriff, as in quadrupeds, and the parts of generation also bear a very strong resemblance and analogy.

Such is the structure of this animal, forming the shade that unites birds and quadrupeds; and from this structure its habits and manners are entirely peculiar. It is a native only of the torrid regions of Africa, and has long been celebrated by those who have had occasion to mention the animals of that region. Its flesh is proscribed in scripture as unfit to be eaten; and most of the ancient writers describe it as well known in their times. Like the race of the elephant, it is transmitted down without mixture; and has never been known to breed out of that country which first produced it. It seems formed to live among the sandy and burning deserts of the torrid zone; and, as in some measure it owes its birth to their genial influence, so it seldom migrates into tracts more mild or more fertile. As that is the peculiar country of the elephant, the rhinoceros, and camel, so it may readily be supposed capable of affording a retreat to the ostrich. They inhabit, from preference, the most solitary and horrid deserts, where there are few vegetables to clothe the surface of the earth, and where the rain never comes to refresh it. The Arabians assert that the ostrich never drinks; and the place of its habitation seems to confirm the assertion. In these formidable regions, ostriches are seen in large flocks, which to the distant spectator appear like a regiment of cavalry, and have often alarmed a whole caravan. There is no desert, how barren soever, but what is capable of supplying these animals with provision; they eat almost every thing; and these barren tracts are thus doubly grateful, as they afford both food and security. The ostrich is, of all other animals, the most voracious. It will devour leather, glass, hair, iron, stones, or any thing that is given. Nor are its powers of digestion less in such things as are digestible. Those substances which the coats of the stomach cannot soften, pass whole; so that glass, stones, or iron, are excluded in the form in which they were devoured. All metals, indeed, which are swallowed by any animal, lose a part of their weight, and often the extremities of their figure, from the action of the juices of the stomach upon their surface. A quarter pistole, which was swallowed by a duck, lost seven grains of its weight in the gizzard before it was voided; and it is probable that a still greater diminution of weight would happen in the stomach of an ostrich. Considered in this light, therefore, this animal may be said to digest iron; but such substances seldom remain long enough in the stomach of any animal to undergo so tedious a dissolution. However this be, the ostrich swallows almost every thing presented to it. Whether this be from the necessity which smaller birds are under of picking up gravel to keep the coats of their stomach asunder, or whether it be from a want of distinguishing by the taste what substances are fit and what incapable of digestion; certain it is, that in the ostrich dissected by Ranby there appeared such a quantity of heterogeneous substances, that it was wonderful how any animal could digest such an overcharge of nourishment. Valisnieri also found the first stomach filled with a quantity of incongruous substances; grass, nuts, cords, stones, glass, brass, copper, iron, tin, lead, and wood; a piece of stone was found among the rest that weighed more than a pound. He saw one of these animals that was killed by devouring a quantity of quick-lime. It would seem that the ostrich is obliged to fill up the great capacity of its stomach in order to be at ease; but that nutritious substances not occurring, it pours in whatever offers to supply the void.

In their native deserts, however, it is probable they live chiefly upon vegetables, where they lead an inoffensive and social life; the male, as Thevenot assures us, assorting with the female with connubial fidelity. They are said to be very much inclined to venery;

and the make of the parts in both sexes seems to confirm the report. It is probable also they copulate, like other birds, by compression; and they lay very large eggs, some of them being above five inches in diameter, and weighing above fifteen pounds. These eggs have a very hard shell, somewhat resembling those of the crocodile, except that those of the latter are less and rounder.[1]

The season for laying depends on the climate where the animal is bred. In the northern parts of Africa, this season is about the beginning of July: in the south, it is about the latter end of December. These birds are very prolific, and lay generally from forty to fifty eggs at one clutch. It has been commonly reported that the female deposits them in the sand; and, covering them up, leaves them to be hatched by the heat of the climate, and then permits the young to shift for themselves. Very little of this, however, is true: no bird has a stronger affection for her young than the ostrich, and none watches her eggs with greater assiduity. It happens, indeed, in those hot climates, that there is less necessity for the continual incubation of the female; and she more frequently leaves her eggs, which are in no fear of being chilled by the weather; but though she sometimes forsakes them by day, she always carefully broods over them by night; and Kolben, who has seen great numbers of them at the Cape of Good Hope, affirms that they sit on their eggs like other birds, and that the male and female take this office by turns, as he had frequent opportunities of observing. Nor is it more true what is said of their forsaking their young after they are excluded the shell. On the contrary, the young ones are not even able to walk for several days after they are hatched. During this time, the old ones are very assiduous in supplying them with grass, and very careful to defend them from danger; nay, they encounter every danger in their defence. It was a way of taking them among the ancients, to plant a number of sharp stakes round the ostrich's nest in her absence, upon which she pierced herself at her return. The young, when brought forth, are of an ash-colour the first year, and are covered with feathers all over. But in time these feathers drop; and those parts which are covered assume a different and more becoming plumage.

The beauty of a part of this plumage, particularly the long feathers that compose the wings and tail,[2] is the chief reason that man has been so active in pursuing this harmless bird to its deserts, and hunting it with no

[1] The male ostrich of South Africa (says the late Mr Thomas Pringle) at the time of breeding usually associates to himself from two to six females. The hens lay all their eggs together in one nest; the nest being merely a shallow cavity scraped in the ground, of such dimensions as to be conveniently covered by one of these gigantic birds in incubation. A most ingenious device is employed to save space, and give at the same time to all the eggs their due share of warmth. The eggs are made to stand each with the narrow end on the bottom of the nest and the broad end upwards; and the earth which has been scraped out to form the cavity is employed to confine the outer circle, and keep the whole in the proper position. The hens relieve each other in the office of incubation during the day, and the male takes his turn at night, when his superior strength is required to protect the eggs or the new-fledged young from the jackalls, tiger-cats, and other enemies. Some of these animals, it is said, are not unfrequently found lying dead near the nest, destroyed by a stroke from the foot of this powerful bird.

As many as sixty eggs are sometimes found in and around an ostrich nest; but a smaller number is more common; and incubation is occasionally performed by a single pair of ostriches. Each female lays from twelve to sixteen eggs. They continue to lay during incubation, and even after the young brood are hatched, the supernumerary eggs are not placed in the nest, but around it, being designed to assist in the nourishment of the young birds, which, though as large as a pullet when first hatched, are probably unable at once to digest the hard and acrid food on which the old ones subsist. The period of incubation is from thirty-six to forty days. In the middle of the day the nest is occasionally left by all the birds, the heat of the sun being then sufficient to keep the eggs at the proper temperature.

An ostrich egg is considered as equal in its contents to twenty-four of the domestic hen. When taken fresh from the nest, as those were which we found near Rhinoceros Fountain, they are very palatable, and are wholesome though somewhat heavy food. The best mode of cooking them is that practised by the Hottentots, and which we adopted under their tuition, namely, to place one end of the egg in the hot ashes, and making a small orifice in the other, keep stirring the contents with a bit of stick till they are sufficiently roasted; and then with a seasoning of salt and pepper you have a very nice omelade.

The ostrich of South Africa is a prudent and wary animal, and displays little of that stupidity ascribed to this bird by some naturalists. On the borders of the Cape Colony, at least, where it is eagerly pursued for the sake of its valuable plumage, the ostrich displays no want of sagacity in providing for its own safety or the security of its offspring. It adopts every possible precaution to conceal the place of its nest; and uniformly abandons it, after destroying the eggs, if it perceives that the eggs have been disturbed or the footsteps of man are discovered near it. In relieving each other in hatching, the birds are said to be careful not to be seen together at the nest, and are never observed to approach it in a direct line.

The food of the ostrich consists of the tops of the various shrubby plants which even the most arid parts of South Africa produce in abundance. This bird is so easily satisfied in regard to water that he is constantly to be found in the most parched and desolate tracts which even the antelopes and the beasts of prey have deserted. His cry at a distance so much resembles that of the lion, that even the Hottentots are said to be sometimes deceived by it.

When not hatching they are frequently seen in troops of thirty or forty together, or amicably associated with herds of zebras or quaggas, their fellow-tenants of the wilderness. If caught young the ostrich is easily tamed; but it does not appear that any attempt has been made to apply his great strength and swiftness to any purpose of practical utility.

[2] It is generally believed that the fine feathers of the

small degree of expense and labour. The ancients used those plumes in their helmets; the ladies of the East make them an ornament in their dress; and, among us, our undertakers and our fine gentlemen still make use of them to decorate their hearses and their hats. Those feathers which are plucked from the animal while alive, are much more valued than those taken when dead; the latter being dry, light, and subject to be worm-eaten.

Beside the value of their plumage, some of the savage nations of Africa hunt them also for their flesh, which they consider as a dainty. They sometimes also breed these birds tame, to eat the young ones, of which the female is said to be the greatest delicacy. Some nations have obtained the name of Struthophagi, or ostrich-eaters, from their peculiar fondness for this food; and even the Romans themselves were not averse to it. Apicius gives a receipt for making sauce for the ostrich; and Heliogabalus is noted for having dressed the brains of six hundred ostriches in one dish; for it was his custom never to eat but of one dish in a day, but that was an expensive one. Even among the Europeans now, the eggs of the ostrich are said to be well tasted, and extremely nourishing; but they are too scarce to be fed upon, although a single egg be a sufficient entertainment for eight men.

As the spoils of the ostrich are thus valuable, it is not to be wondered at that man has become their most assiduous pursuer. For this purpose, the Arabians train up their best and fleetest horses, and hunt the ostrich still in view. Perhaps of all other varieties of the chase, this though the most laborious, is yet the most entertaining. As soon as the hunter comes within sight of his prey, he puts on his horse with a gentle gallop, so as to keep the ostrich still in sight; yet not so as to terrify him from the plain into the mountains. Of all known animals that make use of their legs in running, the ostrich is by far the swiftest; upon observing himself therefore pursued at a distance, he begins to run at first but gently; either insensible of his danger, or sure of escaping. In this situation he somewhat resembles a man at full speed; his wings, like two arms, keep working with a motion correspondent to that of his legs: and his speed would very soon snatch him from the view of his pursuers; but, unfortunately for the silly creature, instead of going off in a direct line, he takes his course in circles; while the hunters still make a small course within, relieve each other, meet him at unexpected turns, and keep him thus still employed, still followed for two or three days together. At last, spent with fatigue and famine, and finding all power of escape impossible, he endeavours to hide himself from those enemies he cannot avoid, and covers his head in the sand, or the first thicket he meets. Sometimes, however, he attempts to face his pursuers; and though in general the most gentle animal in nature, when driven to desperation, he defends himself with his beak, his wings, and his feet. Such is the force of his motion, that a man would be utterly unable to withstand him in the shock.

The Struthophagi have another method of taking this bird; they cover themselves with an ostrich's skin, and passing up an arm through the neck, thus counterfeit all the motions of this animal. By this artifice they approach the ostrich, which becomes an easy prey. He is sometimes also taken by dogs and nets, but the most usual way is that mentioned above.

When the Arabians have thus taken an ostrich, they cut its throat, and making a ligature below the opening, they shake the bird, as one would rince a barrel; then taking off the ligature, there runs out from the wound in the throat a considerable quantity of blood, mixed with the fat of the animal; and this is considered one of their greatest dainties. They next flay the bird; and of the skin, which is strong and thick, sometimes make a kind of vest, which answers the purposes of a cuirass and a buckler.

There are others who, more compassionate or more provident, do not kill their captive, but endeavour to tame it, for the purposes of supplying those feathers which are in so great request. The inhabitants of Dara and Lybia breed up whole flocks of them, and they are tamed with very little trouble. But it is not for their feathers alone that they are prized in this domestic state; they are often ridden upon, and used as horses. Moore assures us, that at Joar he saw a man travelling upon an ostrich; and Adanson asserts, that, at the factory of Podore, he had two ostriches, which were then young, the strongest of which ran swifter than the best English racer, although he carried two negroes on his back. As soon as the animal perceived that it was loaded, it set off running with all its force, and made several circuits round the village; till at length the people were obliged to stop it, by barring up the way. How far this strength and swiftness may be useful to mankind, even in a polished state, is a matter that perhaps deserves inquiry. Posterity may avail themselves of this creature's abilities; and riding upon an ostrich may one day become the favourite, as it most certainly is the swiftest, mode of conveyance.

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ostrich are from the tail of the bird, which is not the fact. They are from the wings. The tail feathers are short, and of little value.

The parts of this animal are said to be convertible to many salutary purposes in medicine. The fat is said to be emollient and relaxing; that while it relaxes the tendons, it fortifies the nervous system; and being applied to the region of the loins, it abates the pains of the stone in the kidneys. The shell of the egg powdered, and given in proper quantities, is said to be useful in promoting urine, and dissolving the stone in the bladder. The substance of the egg itself is thought to be peculiarly nourishing: however, Galen, in mentioning this, asserts, that the eggs of hens and pheasants are good to be eaten; those of geese and ostriches are the worst of all.

CHAP. V.

THE EMU.[1]

Of this bird, which many call the American Ostrich, (see Plate XVIII. fig. 25.) but little is certainly known. It is an inhabitant of the New Continent; and the travellers who have mentioned it, seem to have been more solicitous in proving its affinity to the ostrich, than in describing those peculiarities

[1] The term *Emu* is now applied to the ostrich of New Holland (see Plate XV. fig. 37.) This bird differs in many respects from the African ostrich. It has a straight bill, very much depressed towards the sides, slightly keeled along its middle, and rounded at the point; large nostrils, covered by a membrane and opening above on the middle of the bill; a head unsurmounted by a bony crest, and covered with feathers up to a certain age; a naked throat without wattles; powerful legs of considerable length, fleshy and feathered down to the joint, naked and reticulated below it; three toes directed forwards, the two lateral ones equal in length, and the posterior wholly wanting; the claws of all the toes nearly equal; and no true quill-feathers either to the wings or tail. It is consequently distinguished from the African ostrich by the number of its toes; from it and the rhea by the trifling developement of its wings, and the total want of plumage to the wings and tail; and from the cassowary by the absence of crest, wattles, and quills, the depression of its bill, the position of its nostrils, and the equality of its claws.

In size and bulk the emu is exceeded by the African ostrich alone. It is stated by travellers to attain a height of more than seven feet, and its average measurement in captivity may be estimated at between five and six. In form it closely resembles the ostrich, but is lower on the legs, shorter in the neck, and of a more thickset and clumsy make. At a distance its feathers have more of the appearance of hair than of plumage, their barbs being all loose and separate. As in the other ostriches, they take their origin by pairs from the same shaft. Their general colour is a dull brown mottled with dirty gray, the latter prevailing more particularly on the under surface of the bird. On the head and neck they become gradually shorter, assume still more completely the appearance of hairs, and are so thinly scattered over the fore part of the throat and around the ears, that the skin, which is of a purplish hue, is distinctly visible. This appearance is most remarkable in the older birds, in which these parts are left nearly bare. The wings are so extremely small as to be quite invisible when applied to the surface of the body. They are clothed with feathers exactly similar to those of the back, which, it should be observed, divide as it were from a middle line, and fall gracefully over on either side. The colour of the bill and legs is of a dusky black; and that of the iris dull brown.

There appears to be but little difference in colour between the two sexes; but the young on first quitting the shell have a much more elegant livery. A brood of these has lately been hatched at the society's garden, in which the ground colour is grayish white, marked with two longitudinal broad black stripes along the back, and two similar ones on either side, each subdivided by a narrow middle line of white. These stripes are continued along the neck without subdivision, and are broken on the head into irregular spots. Two other broken stripes pass down the fore part of the neck and breast, and terminate in a broad band passing on either side across the thighs. As in the fully grown bird the bill and legs are of a dusky hue.

These birds appear to be widely spread over the southern part of the continent of New Holland and the neighbouring islands; but we are not aware that they have been hitherto discovered in its tropical regions. They were formerly very abundant in the neighbourhood of Botany Bay and Port Jackson, but have been of late years compelled by the increasing numbers of the settlers to seek shelter in the interior. On the south coast they have been met with in great plenty, at Port Phillip by Captain Flinders, and at King George's Sound by the same officer and the naturalists of the expedition under D'Entrecasteaux. They seem also to be extremely numerous in the adjacent islands, especially in Kanguroo island, where they were found in the greatest abundance by both Flinders and Peron; and in King's island, where the distinguished naturalist last named and his companions were fortunately enabled by the kindness of some English seal-hunters to subsist, chiefly upon emu's flesh, for several days while temporarily deserted by their captain. According to the late accounts from Swan river, they have also been observed on that part of the west coast on which the new settlement is situated.

The emu was first described and figured, under the name of the New Holland cassowary, in Governor Phillip's Voyage to Botany Bay, published in 1789. To this work Dr Latham contributed very considerably in the ornithological department, and it is therefore probable that the description of this remarkable bird was furnished by him. The figure, taken from a drawing made on the spot by lieutenant Watts, is extremely defective. In the ensuing year a second figure, taken from the same specimen as the former, but very different in appearance and equally inaccurate, was given in White's Voyage to New South Wales, the zoological part of which work appears to have been superintended by Dr Shaw, whose Miscellany likewise contains a copy of the same figure. A much better representation, although somewhat too highly coloured, occurs in the Atlas to Peron's Voyage aux Terres Australes.

In its manners the emu bears a close resemblance to the ostrich, as might be expected from their near relationship. Its food appears to be wholly vegetable, consisting chiefly of fruits, roots, and herbage; and it is consequently, notwithstanding its great strength, perfectly inoffensive. The length of its legs, and the muscularity of its thighs, enable it to run with great swiftness; and, as it is exceedingly shy, it is not easily over

which distinguish it from all others of the feathered creation.

It is chiefly found in Guiana, along the banks of the Oroonoko, in the inland provinces of Brazil and Chili, and the vast forests that border on the mouth of the river Plata. Many other parts of South America were known to have them; but as men multiplied, these large and timorous birds either fell beneath their superior power, or fled from their vicinity.

The Emu, though not so large as the ostrich, is only second to it in magnitude. It is by much the largest bird in the New Continent; and is generally found to be six feet high, measuring from its head to the ground. Its legs are three feet long; and its thigh is near as thick as that of a man. The toes differ from those of the ostrich; as there are three in the American bird, and but two in the former. Its neck is long, its head small, and the bill flatted, like that of the ostrich; but in all other respects it more resembles the cassowary, a large bird to be described hereafter. The form of the body appears round; the wings are short, and entirely unfitted for flying, and it wants a tail. It is covered from the back and rump with long feathers, which fall backward, and cover the anus; these feathers are gray upon the back, and white on the belly. It goes very swiftly, and seems assisted in its motion by a kind of tubercle behind, like a heel, upon which, on plain ground, it treads very securely; in its course it uses a very odd kind of action, lifting up one wing, which it keeps elevated for a time; till letting it drop, it lifts up the other. What the bird's intention may be in thus keeping only one wing up, is not easy to discover; whether it makes use of this as a sail to catch the wind, or whether as a rudder to turn its course, in order to avoid the arrows of the Indians, yet remains to be ascertained: however this be, the emu runs with such swiftness, that the fleetest dogs are thrown out in the pursuit. One of them, finding itself surrounded by the hunters, darted among the dogs with such fury, that they made way to avoid its rage; and it escaped, by its amazing velocity, in safety to the mountains.

As this bird is but little known, so travellers have given a loose to their imaginations in describing some of its actions, which they were conscious could not be easily contradicted. This animal, says Nierenberg, is very

taken, or brought within gun-shot. Captain Currie, in Mr Barron Field's Memoirs on New South Wales, states that it affords "excellent coursing, equalling, if not surpassing, the same sport with the hare in England." And Mr Cunningham, in his amusing work entitled Two Years in New South Wales, gives a curious account of the manner in which it is usually coursed by the dogs. The latter gentleman states that dogs will seldom attack it, both on account of some peculiar odour in its flesh which they dislike, and because the injuries which it inflicts upon them by striking out with its feet are frequently very severe. "The settlers even assert," he says, "that they [the emus] will break the small bone of a man's leg by this sort of kick; which to avoid, the well-trained dogs run up abreast, and make a sudden spring at their neck, whereby they are quickly dispatched."

But although dogs in general may be reluctant to attack the emu, this is by no means the case with those which are specially trained for the purpose. M. Peron assures us that the English seal-fishers on King's island in Bass's strait had with them dogs which were taught to go alone into the woods in quest of kanguroos and emus, and rarely failed to destroy several of these animals every day. When the chase was at an end, they returned to their masters' dwelling, made known by signs the success of their expedition, and conducted the hunters to the spot where the quarry was deposited. It was thus that these adventurous traders were enabled to supply themselves with provisions, even while they devoted nearly the whole of their time to the commercial pursuits in which they were engaged. This statement, M. Peron assures us, does not depend on the mere assertions of the fishermen themselves, for he had himself witnessed the fact. From his account of the dogs it does not appear whether they were of the native Australian breed. It is more probable that they were English hounds; and the name of one of them, Spot, adds some confirmation to this conjecture, for we are not aware that the pure New Holland dog has ever been found spotted. In either case the account may be quoted as a surprising instance of animal docility, which would be only the more striking if exhibited by the less sagacious breed.

If we are to credit the report of the same author, the flesh of the emu is "truly exquisite, and intermediate, as it were, between that of a turkey and a sucking-pig." But some allowances must be made for the circumstances in which he first partook of it, when he and his companions, abandoned by their captain, and without any means of procuring subsistence, had no other prospect than that of perishing by starvation, until relieved by the generosity of the fishermen. The English colonists do not appear to have quite so high an opinion of its merits; they compare it to beef, which it resembles, according to Mr Cunningham, "both in appearance and taste, and is good and sweet eating: nothing indeed can be more delicate than the flesh of the young ones." "There is but little," he says, "fit for culinary use upon any part of the emu except the hind-quarters, which are of such dimensions that the shouldering of the two hind-legs homewards for a mile distance, once proved to me as tiresome a task as I ever recollect to have encountered in the colony." Their eggs are held in much estimation, and, according to the same authority, the natives almost live upon them during the hatching season. They are as large as those of an ostrich, with equally thick shells coloured of a beautiful dark green, and are usually six or seven in number; but we have no information as to the manner in which the wild birds form their nest. It probably consists, like that of other ostriches, of a mere cavity scooped in the earth. They seem to pair together with tolerable constancy, and the male bird, as in some other monogamous races, sits and hatches the young. In captivity the emus are perfectly tame, and speedily become domesticated. They are easily acclimated in this country, and have been bred without difficulty in various collections. —*Gardens and Menagerie of the Zoological Society Delineated. Vol. II*

peculiar in hatching of its young. The male compels twenty or thirty of the females to lay their eggs in one nest; he then, when they have done laying, chases them away, and places himself upon the eggs; however, he takes the singular precaution of laying two of the number aside, which he does not sit upon. When the young ones come forth, these two eggs are addled; which the male having foreseen, breaks one, and then the other, upon which multitudes of flies are found to settle; and these supply the young brood with a sufficiency of provision, till they are able to shift for themselves.

On the other hand, Wafer asserts, that he has seen great quantities of this animal's eggs on the desert shores, north of the river Plata; where they were buried in the sand, in order to be hatched by the heat of the climate. Both this, as well as the preceding account, may be doubted; and it is more probable that it was the crocodile's eggs which Wafer had seen, which are undoubtedly hatched in that manner.

When the young ones are hatched, they are familiar, and follow the first person they meet. I have been followed myself, says Wafer, by many of these young ostriches; which, at first, are extremely harmless and simple; but as they grow older, they become more cunning and distrustful; and run so swift, that a greyhound can scarcely overtake them. Their flesh, in general, is good to be eaten; especially if they be young. It would be no difficult matter to rear up flocks of these animals tame, particularly as they are naturally so familiar: and they might be found to answer domestic purposes, like the hen or the turkey. Their maintenance could not be expensive, if, as Narborough says, they live entirely upon grass.

CHAP. VI.

THE CASSOWARY.[1]

(See Plate XVIII. fig. 23.)

The Cassowary is a bird which was first brought into Europe by the Dutch, from Java, in the East Indies, in which part of the world it is only to be found. Next to the preceding, it is the largest and the heaviest of the feathered species.

The cassowary, though not so large as the former, yet appears more bulky to the eye; its body being nearly equal, and its neck and legs much thicker and stronger in proportion; this conformation gives it an air of strength and force, which the fierceness and singularity of its countenance conspire to render formidable. It is five feet and a half long, from the point of the bill to the extremity of the claws. The legs are two feet and a half high, from the belly to the end of the claws. The head and neck together are a foot and a half; and the largest toe, including the claw, is five inches long. The claw alone of the least toe, is three inches and a half in length. The wing is so small, that it does not appear; it being hid under the feathers of the back. In other birds, a part of the feathers serve for flight, and are different from those that serve for merely covering; but in the cassowary, all the feathers are of the same kind, and outwardly of the same colour. They are generally double; having two long shafts, which grow out of a short one, which is fixed in the skin. Those that are double, are always of an unequal length; for some are fourteen inches long, particularly on the rump; while others are not above three. The beards that adorn the stem or shaft, are, from about half way to the end, very long, and as thick as a horse hair, without being subdivided into fibres. The stem or shaft is flat, shining, black, and knotted below; and from each knot there proceeds a beard: likewise the

[1] This scarce and remarkable bird (the *Struthio Casuarius* of Linnæus) is found in India, and the most eastern part of the old continent. Even in its native regions it is uncommon; and few are domesticated. The habitual dulness of these birds, their disagreeable voice, and their hard, black flesh, offer no compensation for the cost of rearing and supporting them. The wild cassowary feeds on fruits, tender roots, and occasionally on the young of small animals. The tame are fed not only on fruits, but on bread, of which they consume about four pounds a-day. They run very swiftly, and often outstrip the fleetest horses. They resist dogs by dealing them severe blows with their feet. The male bird generally leaves his mate to the cares of incubation, which are required only at night; for during the day, their three greyish eggs spotted with green, are exposed to the vivifying effects of the sun, being slightly covered with sand in the hole where they have been laid. In captivity, their incubation lasts eight and twenty days. The first cassowary ever seen in Europe was brought by the Dutch in 1597.

The head of the cassowary is almost bare, covered with a bluish skin, out of which grow a few scattered hairs. It is crowned with a conical helmet, brown in front and yellow in other parts; this helmet is formed by the swelling of the skull-bones. The throat is overspread with spongy glandular membranes, of a red and violet colour, which hang down in front. The body is covered with feathers of a bluish-black, of a particular character, somewhat similar to long thin hair. The feather of the wing, or what represents the wing, for it is not made for flight, consists of five hollow pipes, free from hair, and red towards the bottom.

The whole length, from the beak to the rump, of the full-grown bird, is rather more than five feet. The young bird has no helmet, and his plumes are of a light red colour, mixed with gray.

beards at the end of the large feathers are perfectly black; and towards the root of a gray tawny colour; shorter, more soft, and throwing out fine fibres like down; so that nothing appears except the ends, which are hard and black; because the other part, composed of down, is quite covered. There are feathers on the head and neck; but they are so short and thinly sown, that the bird's skin appears naked, except towards the hinder part of the head, where they are a little longer. The feathers which adorn the rump are extremely thick; but do not differ, in other respects, from the rest, excepting their being longer. The wings, when they are deprived of their feathers, are but three inches long; and the feathers are like those on other parts of the body. The ends of the wings are adorned with five prickles, of different lengths and thickness, which bend like a bow; these are hollow from the roots to the very points, having only that slight substance within, which all quills are known to have. The longest of these prickles is eleven inches; and it is a quarter of an inch in diameter at the root, being thicker there than towards the extremity; the point seems broken off.

The part, however, which most distinguishes this animal is the head: this, though small, like that of an ostrich, does not fail to inspire some degree of terror. It is bare of feathers, and is in a manner armed with a helmet of horny substance, that covers it from the root of the bill to near half the head backwards. This helmet is black before and yellow behind. Its substance is very hard, being formed by the elevation of the bone of the skull; and it consists of several plates, one over another, like the horn of an ox. Some have supposed that this was shed every year with the feathers; but the most probable opinion is, that it only exfoliates slowly like the beak. To the peculiar oddity of this natural armour may be added the colour of the eye in this animal, which is a bright yellow, and the globe being above an inch and a half in diameter, gives it an air equally fierce and extraordinary. At the bottom of the upper eye-lid, there is a row of small hairs, over which there is another row of black hair, which look pretty much like an eye-brow. The lower eyelid, which is the largest of the two, is furnished also with plenty of black hair. The hole of the ear is very large and open, being only covered with small black feathers. The sides of the head, about the eye and ear, being destitute of any covering, are blue, except the middle of the lower eye-lid, which is white. The part of the bill which answers to the upper jaw in other animals, is very hard at the edges above, and the extremity of it like that of a turkey-cock. The end of the lower mandible is slightly notched, and the whole is of a grayish brown, except a green spot on each side. As the beak admits a very wide opening, this contributes not a little to the bird's menacing appearance. The neck is of a violet colour, inclining to that of slate; and it is red behind in several places, but chiefly in the middle. About the middle of the neck before, at the rise of the large feathers, there are two processes formed by the skin, which resemble somewhat the gills of a cock, but that they are blue as well as red. The skin which covers the fore-part of the breast, on which this bird leans and rests, is hard, callous, and without feathers. The thighs and legs are covered with feathers, and are extremely thick, strong, straight, and covered with scales of several shapes; but the legs are thicker a little above the foot than in any other place. The toes are likewise covered with scales, and are but three in number; for that which should be behind is wanting. The claws are of a hard solid substance, black without, and white within.

The internal parts are equally remarkable. The cassowary unites with the double stomach of animals that live upon vegetables, the short intestines of these that live upon flesh. The intestines of the cassowary are thirteen times shorter than those of the ostrich. The heart is very small, being but an inch and a half long, and an inch broad at the base. Upon the whole, it has the head of a warrior, the eye of a lion, the defence of a porcupine, and the swiftness of a courser.

Thus formed for a life of hostility, for terrifying others, and for its own defence, it might be expected that the cassowary was one of the most fierce and terrible animals of the creation. But nothing is so opposite to its natural character, nothing so different from the life it is contented to lead. It never attacks others; and instead of the bill, when attacked, it rather makes use of its legs, and kicks like a horse, or runs against its pursuer, beats him down, and treads him to the ground.

The manner of going of this animal is not less extraordinary than its appearance. Instead of going directly forward, it seems to kick up behind with one leg, and then making a bound onward with the other, it goes with such prodigious velocity, that the swiftest racer would be left far behind.

The same degree of voraciousness which we perceive in the ostrich, obtains as strongly here. The cassowary swallows every thing that comes within the capacity of its gullet. The Dutch assert, that it can devour not only glass, iron, and stones, but even live on burning coals, without testifying the smallest fear, or feeling the least injury. It is said, that the passage of the food through its gullet is performed so

speedily, that even the very eggs which it has swallowed whole, pass through it unbroken, in the same form they went down. In fact, the alimentary canal of this animal, as was observed above, is extremely short; and it may happen that many kinds of food are indigestible in its stomach, as wheat or currants are to a man when swallowed whole.

The cassowary's eggs are of a gray ash colour, inclining to green. They are not so large nor so round as those of the ostrich. They are marked with a number of little tubercles of a deep green, and the shell is not very thick. The largest of these is found to be fifteen inches round one way, and about twelve the other.

The southern parts of the most eastern Indies seems to be the natural climate of the cassowary. His domain, if we may so call it, begins where that of the ostrich terminates. The latter has never been found beyond the Ganges; while the cassowary is never seen nearer than the islands of Banda, Sumatra, Java, the Molucca Islands, and the corresponding parts of the continent. Yet even here this animal seems not to have multiplied in any considerable degree, as we find one of the kings of Java making a present of one of these birds to the captain of a Dutch ship, considering it as a very great rarity. The ostrich, that has kept in the desert and unpeopled regions of Africa, is still numerous, and the unrivalled tenant of its own inhospitable climate. But the cassowary, that is the inhabitant of a more peopled and polished region, is growing scarcer every day. It is thus that in proportion as man multiplies, all the savage and noxious animals fly before him: at his approach they quit their ancient habitations, how adapted soever they may be to their natures, and seek a more peaceable, though barren, retreat; where they willingly exchange plenty for freedom; and encounter all the dangers of famine, to avoid the oppressions of an unrelenting destroyer.

CHAP. VII.

THE DODO.

(*See Plate XX. fig.* 28.)

Mankind have generally made swiftness the attribute of birds; but the dodo has no title to this distinction. Instead of exciting the idea of swiftness by its appearance, it seems to strike the imagination as a thing the most unwieldy and inactive of all nature. Its body is massive, almost round, and covered with gray feathers; it is just barely supported upon two short thick legs, like pillars, while its head and neck rise from it in a manner truly grotesque. The neck, thick and pursy, is joined to the head, which consists of two great chaps, that open far behind the eyes, which are large, black and prominent; so that the animal, when it gapes, seems to be all mouth. The bill, therefore, is of an extraordinary length, not flat and broad, but thick, and of a bluish white, sharp at the end, and each chap crooked in opposite directions. They resemble two pointed spoons that are laid together by the backs. From all this results a stupid and voracious physiognomy; which is still more increased by a bordering of feathers round the root of the beak, and which gives the appearance of a hood or cowl, and finishes this picture of stupid deformity. Bulk, which in other animals implies strength, in this only contributes to inactivity. The ostrich, or the cassowary, are no more able to fly than the animal before us; but then they supply that defect by their speed in running. The dodo seems weighed down by its own heaviness, and has scarcely strength to urge itself forward. It seems among birds what the sloth is among quadrupeds, an unresisting thing, equally incapable of flight or defence. It is furnished with wings, covered with soft ash-coloured feathers, but they are too short to assist it in flying. It is furnished with a tail, with a few small curled feathers; but this tail is disproportioned and displaced. Its legs are too short for running, and its body too fat to be strong. One would take it for a tortoise that had supplied itself with the feathers of a bird; and that thus dressed out with the instruments of flight, it was only still the more unwieldy.

This bird is a native of the Isle of France; and the Dutch, who first discovered it there, called it, in their language, the nauseous bird, as well from its disgusting figure as from the bad taste of its flesh. However, succeeding observers contradict the first report, and assert that its flesh is good and wholesome eating. It is a silly simple bird, as may very well be supposed from its figure, and is very easily taken. Three or four dodos are enough to dine a hundred men.

Whether the dodo be the same bird with that which some travellers have described under the bird of Nazareth, yet remains uncertain. The country from whence they both come is the same; their incapacity of flying is the same; the form of the wings and body in both are similar; but the chief difference given is in the colour of the feathers, which in the female of the bird of Nazareth are said to be extremely beautiful; and in the length of their legs, which in the dodo are short; in the other, are described as long. Time and future observation must clear up these doubts;

and the testimony of a single witness, who shall have seen both, will throw more light on the subject than the reasonings of a hundred philosophers.[1]

[1] The dodo, described above, is now supposed to have become extinct, and its former existence has even been called in question by some writers. Instead of entering upon this subject, which has been very largely discussed by naturalists, and which could not be treated of without occupying much room, we refer to a paper by Mr Duncan, in the 12th No. of the Zoological Journal, where the most complete view of the evidence as to the recent existence and present extinction of the dodo is given.

HISTORY OF BIRDS.

BOOK II.

OF RAPACIOUS BIRDS.

CHAP. I.

OF RAPACIOUS BIRDS IN GENERAL.[1]

There seems to obtain a general resemblance in all the classes of nature. As among quadrupeds, a part were seen to live upon the vegetable productions of the earth, and another part upon the flesh of each other; so among birds, some live upon vegetable food, and others by rapine, destroying all such as want force or swiftness to procure their safety. By thus peopling the woods with animals of different dispositions, nature has wisely provided for the multiplication of life; since, could we suppose that there were as many animals produced as there were vegetables supplied to sustain them, yet there might still be another class of animals formed, which could find a sufficient sustenance by feeding upon such of the vegetable feeders as happened to fall by the course of nature. By this contrivance, a greater number will be sustained upon the whole; for the numbers would be but very thin were every creature a candidate for the same food. Thus, by supplying a variety of appetites, nature has also multiplied life in her productions.

In thus varying their appetites, nature has also varied the form of the animal; and while she has given some an instinctive passion for animal food, she has also furnished them with powers to obtain it. All land birds of the rapacious kinds are furnished with a large head, and a strong crooked beak, notched at the end, for the purpose of tearing their prey. They have strong short legs, and sharp crooked talons, for the purpose of seizing it. Their bodies are formed for war, being fibrous and muscular; and their wings for swiftness of flight, being well feathered and expansive. The sight of such as prey by day is astonishingly quick; and such as ravage by night, have their sight so fitted as to see objects in darkness with extreme precision.

Their internal parts are equally formed for the food they seek for. Their stomach is simple and membranous, and wrapt in fat to increase the powers of digestion; and their intestines are short and glandular. As their food is succulent and juicy, they want no length of intestinal tube to form it into a proper nourishment. Their food is flesh; which does not require a slow digestion to be converted into a similitude of substance to their own.

Thus formed for war, they lead a life of solitude and rapacity. They inhabit by choice the most lonely places, and the most desert mountains. They make their nests in the clifts of rocks, and on the highest and most inaccessible trees of the forest. Whenever they appear in the cultivated plain or the warbling grove, it is only for the purposes of depredation; and are gloomy intruders on the general joy of the landscape. They spread terror wherever they approach: all that variety of music which but a moment before enlivened the grove, at their appearing is instantly at an end: every order of lesser birds seek for safety, either by concealment or flight; and some are even driven to take protection with man, to avoid their less merciful pursuers.

It would indeed be fatal to all the smaller race of birds, if, as they are weaker than all, they were also pursued by all; but it is contrived wisely for their safety, that every order of carnivorous birds seek only for such as are of the size most approaching their own. The eagle flies at the bustard or the pheasant; the

[1] The animals of this order are all carnivorous: they associate in pairs, build their nests in the most lofty situations, and produce generally four young ones at a brood: and the female is mostly larger than the male. They consist of vultures, eagles, hawks, and owls.

sparrow-hawk pursues the thrush and linnet. Nature has provided that each species should make war only on such as are furnished with adequate means of escape. The smallest birds avoid their pursuers by the extreme agility, rather than the swiftness of their flight; for every order would soon be at an end, if the eagle, to its own swiftness of wing, added the versatility of the sparrow.

Another circumstance which tends to render the tyranny of these animals more supportable, is, that they are less fruitful than other birds; breeding but few at a time. Those of the larger kind seldom produce above four eggs, often but two; those of the smaller kinds, never above six or seven. The pigeon, it is true, which is their prey, never breeds above two at a time; but then she breeds every month in the year. The carnivorous kinds only breed annually, and, of consequence, their fecundity is small in comparison.

As they are fierce by nature, and are difficult to be tamed, so this fierceness extends even to their young, which they force from the nest sooner than birds of the gentler kind. Other birds seldom forsake their young till able, completely, to provide for themselves: the rapacious kinds expel them from the nest at a time when they still should protect and support them. This severity to their young proceeds from the necessity of providing for themselves. All animals that, by the conformation of their stomach and intestines, are obliged to live upon flesh, and support themselves by prey, though they may be mild when young, soon become fierce and mischievous, by the very habit of using those arms with which they are supplied by nature. As it is only by the destruction of other animals that they can subsist, they become more furious every day; and even the parental feelings are overpowered in their general habits of cruelty. If the power of obtaining a supply be difficult, the old ones soon drive their brood from the nest to shift for themselves, and often destroy them in a fit of fury caused by hunger.

Another effect of this natural and acquired severity is, that almost all birds of prey are unsociable. It has long been observed by Aristotle, that all birds with crooked beaks and talons are solitary: like quadrupeds of the cat kind, they lead a lonely wandering life, and are united only in pairs, by that instinct which overpowers their rapacious habits of enmity with all other animals. As the male and female are often necessary to each other in their pursuits, so they sometimes live together; but except at certain seasons, they most usually prowl alone; and, like robbers, enjoy in solitude the fruits of their plunder.

All birds of prey are remarkable for one singularity, for which it is not easy to account. All the males of these birds are about a third less, and weaker than the females, contrary to what obtains among quadrupeds, among which the males are always the largest and the boldest: from thence the male is called by falconers a *tarcel;* that is, a tierce or third less than the other. The reason of this difference cannot proceed from the necessity of a larger body in the female for the purpose of breeding, and that her volume is thus increased by the quantity of her eggs; for in other birds, that breed much faster, and that lay in much greater proportion, such as the hen, the duck, or the pheasant, the male is by much the largest of the two.

Whatever be the cause, certain it is, that the females, as Willoughby expresses it, are of greater size, more beautiful and lovely for shape and colours, stronger, more fierce and generous, than the males; whether it may be that it is necessary for the female to be thus superior, as it is incumbent upon her to provide, not only for herself, but her young ones also.

These birds, like quadrupeds of the carnivorous kind, are all lean and meagre. Their flesh is stringy and ill-tasted, soon corrupting, and tinctured with the flavour of that animal food upon which they subsist. Nevertheless, Belonius asserts, that many people admire the flesh of the vulture and falcon, and dress them for eating, when they meet with any accident that unfits them for the chase. He asserts, that the osprey, a species of the eagle, when young, is excellent food; but he contents himself with advising us to breed these birds up for our pleasure rather in the field, than for the table.

Of land birds of a rapacious nature, there are five kinds. The eagle kind, the hawk kind, the vulture kind, the horned and the screech owl kind. The distinctive marks of this class are taken from their claws and beak: their toes are separated: their legs are feathered to the heel: their toes are four in number; three before, one behind; their beak is short, thick, and crooked.

The eagle kind is distinguished from the rest by his beak, which is straight till towards the end, when it begins to hook downwards.

The vulture kind is distinguished by the head and neck; which are without feathers.

The hawk kind by the beak; being hooked from the very root.

The horned owl by the feathers at the base of the bill standing forwards; and by some feathers on the head that stand out, resembling horns.

The screech-owl by the feathers at the base of the bill standing forward, and being with-

out horns. A description of one in each kind, will serve for all the rest.

CHAP. II.

THE EAGLE AND ITS AFFINITIES.

The Golden Eagle is the largest and the noblest of all those birds that have received the name of eagle. It weighs above twelve



pounds. Its length is three feet; the extent of its wings, seven feet four inches; the bill is three inches long, and of a deep blue colour; and the eye of a hazel colour. The sight and sense of smelling, are very acute. The head and neck are clothed with narrow sharp-pointed feathers, and of a deep brown colour, bordered with tawny; but those on the crown of the head, in very old birds, turn gray. The whole body, above as well as beneath, is of a dark brown; and the feathers of the back are finely clouded with a deeper shade of the same. The wings, when clothed, reach to the end of the tail. The quill-feathers are of a chocolate colour, the shafts white. The tail is of a deep brown, irregularly barred and blotched with an obscure ash-colour, and usually white at the roots of the feathers. The legs are yellow, short, and very strong, being three inches in circumference, and feathered to the very feet. The toes are covered with large scales, and armed with the most formidable claws, the middle of which are two inches long.

In the rear of this terrible bird follow the *ring-tailed eagle*,[1] the *common eagle*, the *bald eagle*, the *white eagle*, the *kough-footed eagle*, the *erne*, the *black eagle*, the *osprey*, the *sea eagle*, and the *crowned eagle*. These, and others that might be added, form different shades in this fierce family; but have all the same rapacity, the same general form, the same habits, and the same manner of bringing up their young.

In general, these birds are found in mountainous and ill-peopled countries, and breed among the loftiest cliffs. They choose those places which are remotest from man, upon whose possessions they but seldom make their depredations, being contented rather to follow the wild game in the forest, than to risk their safety, to satisfy their hunger.

This fierce animal may be considered among birds, as the lion among quadrupeds; and in many respects they have a strong similitude to each other. They are both possessed of force, and an empire over their fellows of the forest. Equally magnanimous, they disdain smaller plunder; and only pursue animals worthy the conquest. It is not till after having been long provoked, by the cries of the rook or the magpie, that this generous bird thinks fit to punish them with death: the eagle also disdains to share the plunder of another bird; and will take up with no other prey but that which he has acquired by his own pursuits. How hungry soever he may be, he never stoops to carrion; and when satiated, he never returns to the same carcase, but leaves it for other animals, more rapacious and less delicate than he. Solitary, like the lion, he keeps the desert to himself alone; it is as extraordinary to see two pair of eagles in the same mountain, as two lions in the same forest. They keep separate, to find a more ample supply; and consider the quantity of their game as the best proof of their dominion. Nor does the similitude of these animals stop here: they have both sparkling eyes, and nearly of the same colour; their claws are of the same form, their breath equally strong, and their cry equally loud and terrifying. Bred both for war, they are enemies of all society: alike fierce, proud, and incapable of being easily tamed. It requires great patience and much art to tame an eagle; and even though taken young, and brought under by long assiduity, yet still it is a dangerous domestic, and often turns its force against its master.

When brought into the field for the purposes of fowling, the falconer is never sure of its attachment: that innate pride, and love of liberty, still prompt it to regain its native solitudes; and the moment the falconer sees it, when let loose, first stoop towards the ground, and then rise perpendicularly into the clouds, he gives up all his former labour for lost; quite sure of never beholding his late prisoner more. Sometimes, however, they are brought to have an attachment for their feeder; they are then highly serviceable, and liberally provide for his pleasures and support. When the falconer lets them go from his hand, they play about and hover round him till their game presents, which they see at an immense distance, and pursue with certain destruction.

Of all animals the eagle flies highest; and from thence the ancients have given him the

[1] The ring-tailed eagle is now generally believed to be the young of the golden eagle.

epithet of *the bird of heaven.* Of all others also, he has the quickest eye; but his sense of smelling is far inferior to that of the vulture. He never pursues, therefore, but in sight; and when he has seized his prey, he stoops from his height, as if to examine its weight, always laying it on the ground before he carries it off. As his wing is very powerful, yet, as he has but little suppleness in the joints of the leg, he finds it difficult to rise when down; however, if not instantly pursued, he finds no difficulty in carrying off geese and cranes. He also carries away hares, lambs, and kids; and often destroys fawns and calves, to drink their blood, and carries a part of their flesh to his retreat. Infants themselves, when left unattended, have been destroyed by these rapacious creatures; which probably gave rise to the fable of Ganymede's being snatched up by an eagle to heaven.

An instance is recorded in Scotland of two children being carried off by eagles; but fortunately they received no hurt by the way; and, the eagles being pursued, the children were restored unhurt out of the nests to the affrighted parents.

The eagle is thus at all times a formidable neighbour; but peculiarly when bringing up its young. It is then that the female, as well as the male, exert all their force and industry to supply their young. Smith, in his history of Kerry, relates, that a poor man in that country got a comfortable subsistence for his family, during a summer of famine, out of an eagle's nest, by robbing the eaglets of food, which was plentifully supplied by the old ones. He protracted their assiduity beyond the usual time, by clipping their wings, and retarding the flight of the young; and very probably also, as I have known myself, by so tying them as to increase their cries, which is always found to increase the parent's despatch to procure them provision. It was lucky, however, that the old eagles did not surprise the country-man as he was thus employed, as their resentment might have been dangerous.

It happened some time ago, in the same country, that a peasant resolved to rob the nest of an eagle, that had built in a small island in the beautiful lake of Killarney. He accordingly stripped, and swam in upon the island while the old ones were away; and, robbing the nest of its young, he was preparing to swim back, with the eaglets tied in a string; but while he was yet up to his chin in the water, the old eagles returned, and, missing their young, quickly fell upon the plunderer, and, in spite of all his resistance, despatched him with their beaks and talons.

In order to extirpate these pernicious birds, there is a law in the Orkney Islands, which entitles any person that kills an eagle to a hen out of every house in the parish in which the plunderer is killed.[1]

[1] In England and the south of Scotland the golden eagle may be accounted rare, very few districts of the former being adapted to its disposition, or suitable for breeding places. Some parts of Derbyshire are recorded as having possessed eyries; in the mountainous parts of Wales there are others, and the precipices of Cumberland and Westmoreland also boasted of them. Upon the wild ranges of the Scottish Border, one or two pairs used to breed, but their nest has not been known for twenty years, though a straggler in winter sometimes is yet seen amidst their defiles. It is not until we really enter the Highlands of Scotland by one of the grand and romantic passes, that this noble bird can be said occasionally to occur, and it is not until we reach the very centre of their "wildness," that he can be frequently seen. But the species must be gradually, though surely decreasing, for such is the depredation committed among the flocks during the season of lambing, and which is the time when a large supply of food is required by the parent birds for their young, that every device is employed, and expense incurred by rewards, for their destruction. From March, 1831, to March, 1834, in the county of Sutherland alone, one hundred and seventy-one old birds, with fifty-three young and eggs, were destroyed, which, while it shows that the bird is not of that extreme rarity which is sometimes supposed, it, at the same time, tells us that if the war of extermination be continued, we shall ere long look in vain for this appropriate ornament of our northern landscape. In Ireland it is generally distributed where the situations are favourable, but at the same time is much more uncommon than the sea eagle. The Horn Head, the mountain of Rosheen, near Dunfanaghy, Achill Island, and Crowpatric, are mentioned by Mr Thompson as now or formerly containing eyries on their precipices; from Rosheen they have been now driven off, on account of the destruction done to the flocks. The nest, placed on a ledge perfectly inaccessible, was set on fire by burning a lighted brand, and was consumed with its tenants; the parents have since forsaken a station where they had been attacked in a manner so unusual.

The eyry of the golden eagle is placed on the face of some stupendous cliff situated inland; the nest is built on a projecting shelve, or on some stumped tree that grows from the rock, generally in a situation perfectly inaccessible without some artificial means, and often out of the reach of shot either from below or from the top of the precipice. It is composed of dead branches, roots of heather, &c., entangled strongly together, and in considerable quantity, but without any lining in the inside; the eggs are two in number, white, with pale brown or purplish blotches, most numerous and largest at the thicker end. During the season of incubation, the quantity of food that is procured and brought hither is almost incredible; it is composed of nearly all the inhabitants, or their young, of those wild districts called forests, which, though indicating a wooded region, are often tracts where for miles around a tree is not seen. Hares, lambs, and the young of deer and roebuck, grouse, black game, ptarmigan, curlews, and plovers, all contribute to the feast.

The manner in which the eagles hunt or survey the ground is by soaring above, often to an immense height; the ascent is performed by circles, a beautiful appearance in flight. When the prey is perceived, it is rushed upon by a rapid and instantaneous sweep; and surprised ere it can escape, or paralyzed by terror, the object is generally at once seized. The weight of the birds and the great resistance presented to the air by their large bodies

The nest of the eagle is usually built in the most inaccessible cliff of the rock, and often shielded from the weather by some jutting crag that hangs over it. Sometimes, however, it is wholly exposed to the winds, as well sideways as above; for the nest is flat, though built with great labour. It is said that the same nest serves the eagle during life; and indeed the pains bestowed in forming it seems to argue as much. One of these was found in the Peak of Derbyshire; which Willoughby thus describes. "It was made of great sticks, resting one end on the edge of a rock, the other on two birch trees. Upon these was a layer of rushes, and over them a layer of heath, and upon the heath rushes again: upon which lay one young one, and an addle egg; and by them a lamb, a hare, and three heathpoults. The nest was about two yards square, and had no hollow in it. The young eagle was of the shape of a goshawk, of almost the weight of a goose, rough footed, or feathered down to the foot, having a white ring about the tail." Such is the place where the female eagle deposits her eggs; which seldom exceed two at a time in the largest species, and not above three in the smallest. It is said that she hatches them for thirty days: but frequently, even of this small number of eggs, a part is addled; and it is extremely rare to find three eaglets in the same nest. It is asserted, that as soon as the young ones are somewhat grown, the mother kills the most feeble or the most voracious. If this happens, it must proceed only from the necessities of the parent, who is incapable of providing for their support; and is content to sacrifice a part to the welfare of all.

The plumage of the eaglets is not so strongly marked as when they come to be adult. They are at first white; then inclining to yellow; and at last of a light brown. Age, hunger, long captivity, and diseases, make them whiter. It is said they live above a hundred years; and that they at last die, not of old age, but from the beaks turning inward upon the under mandible, and thus preventing their taking any food. They are equally remarkable, says Mr Pennant, for their longevity, and for their power of sustaining a long abstinence from food. One of this species, which has now been nine years in the possession of Mr Owen Holland, of Conway, lived thirty-two years with the gentleman who made him a present of it; but what its age was when the latter received it from Ireland is unknown. The same bird also furnishes a proof of the truth of the other remark; having once, through the neglect of servants, endured hunger for twenty-one days, without any sustenance whatever.

Those eagles which are kept tame, are fed with every kind of flesh, whether fresh or corrupting; and when there is a deficiency of that, bread, or other provision, will suffice. It is very dangerous approaching them if not quite tame; and they sometimes send forth a loud piercing lamentable cry, which renders them still more formidable. The eagle drinks but seldom; and perhaps, when at liberty, not at all, as the blood of its prey serves to quench its thirst. The eagle's excrements are always soft and moist, and tinged with that whitish substance which, as was said before, mixes in birds with the urine.

Such are the general characteristics and habitudes of the eagle; however, in some these habitudes differ, as the sea eagle and the osprey live chiefly upon fish, and consequently build their nests on the shore, and by the sides of rivers on the ground among reeds; and often lay three or four eggs, rather less than those of a hen, of a white elliptical form. They catch their prey, which is chiefly fish, by darting down upon them from above. The Italians compare the violent descent of these birds on their prey to the fall of lead into water; and call them *aquila piombina*, or the leaden eagle.

Nor is the bald eagle, (see Plate XV. fig. 2.) which is an inhabitant of North Carolina, less remarkable for habits peculiar to itself. These birds breed in that country all the year round. When the eaglets are just covered

and expansive wings, prevent pursuit being often tried, though we have instances mentioned. Montague relates one where a wounded grouse was seized before the guns could be reloaded, and another, where a black cock was sprung and instantly pursued; "the eagle made several pounces in our view, but without success."

Mr Thompson has given us the following information of the manner of hunting.—An eagle was seen by Mr Adams, lately gamekeeper at Glencairn, in pursuit of a hare. The poor animal took refuge under every bush that presented itself, which, as often as she did, the eagle approached the bush, so near apparently to beat the top of it with his wings, and thereby forced the hare to leave her place of refuge. In this way she was eventually driven to open ground, which did not long avail, as the eagle soon came up with and bore her off. Another anecdote is related on the authority of a sporting friend. "When out hunting among the Belfast mountains, an eagle appeared above his hounds as they came to fault on the ascent to Devis, the highest of the chain. As they came on the scent again, and were at full cry, the eagle for a short time kept above them, but at length advanced and carried off the hare, when at the distance of from three to four hundred paces before the hounds."

The distribution of this species extends over the northern parts of Europe; but towards the south the birds become less frequent. It also inhabits North America, but appears to be there generally rare, although in the United States, according to Audubon, it is frequently seen. In the fur countries it again becomes rare; and the above mentioned naturalist saw a single specimen only on the coast of Labrador, "sailing at the height of a few yards above the moss-covered surface of the dreary rocks."—*Naturalist's Library, vol. IX. by Sir William Jardine, Bart.* Edin. 1838.

with down, and a sort of white woolly feathers, the female eagle lays again. These eggs are left to be hatched by the warmth of the young ones that continue in the nest; so that the flight of one brood makes room for the next that are but just hatched. These birds fly very heavily; so that they cannot overtake their prey, like others of the same denomination. To remedy this, they often attend a sort of fishing-hawk, which they pursue, and strip the plunderer of its prey. This is the more remarkable, as this hawk flies swifter than they. These eagles also generally attend upon fowlers in the winter; and when any birds are wounded, they are sure to be seized by the eagle, though they may fly from the fowler. This bird will often also steal young pigs, and carry them alive to the nest, which is composed of twigs, sticks, and rubbish; it is large enough to fill the body of a cart; and is commonly full of bones half eaten, and putrid flesh, the stench of which is intolerable.[1]

The distinctive marks of each species are as follow:

The *golden eagle*: of a tawny iron colour; the head and neck of a reddish iron; the tail feathers of a dirty white, marked with cross bands of tawny iron; the legs covered with tawny iron feathers.

The *common eagle*: of a brown colour; the head and upper part of the neck inclining to red; the tail feathers white, blackening at the ends; the outer ones, on each side, of an ash colour; the legs covered with feathers of a reddish brown.

The *bald eagle*: brown; the head, neck, and tail feathers, white; the feathers of the upper part of the leg brown.

The *white eagle*: the whole white.

The *rough-footed eagle*: of a dirty brown; spotted under the wings, and on the legs, with white; the feathers of the tail white at the beginning and the point; the leg-feathers dirty brown, spotted with white.

The *white-tailed eagle*: dirty brown; head white; the stems of the feathers black; the rump inclining to black: the tail feathers, the first half black, the end half white; legs naked.[2]

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[1] Wilson, in his American Ornithology, gives the following spirited description of the bald or white-headed eagle.

The celebrated cataract of Niagara, he says, is a noted place of resort for those birds, as well on account of the fish procured there, as for the numerous carcasses of squirrels, deer, bears, and various other animals, that in their attempts to cross the river above the falls have been dragged into the current, and precipitated down that tremendous gulf, where, among the rocks that bound the rapids below, they furnish a rich repast for the vulture, the raven, and the bald eagle, the subject of the present account.

This bird has been long known to naturalists, being common to both continents, and occasionally met with from a very high northern latitude, to the borders of the torrid zone, but chiefly in the vicinity of the sea, and along the shores and cliffs of our lakes and large rivers. Formed by nature for braving the severest cold; feeding equally on the produce of the sea and of the land: possessing powers of flight capable of outstripping even the tempests themselves; unawed by anything but man; and from the ethereal heights to which he soars, looking abroad, at one glance, on an immeasurable expanse of forests, fields, lakes, and ocean, deep below him, he appears indifferent to the little localities of change of seasons; as in a few minutes he can pass from summer to winter, from the lower to the higher regions of the atmosphere, the abode of eternal cold, and from thence descend at will to the torrid or the arctic regions of the earth. He is therefore found at all seasons in the countries he inhabits, but prefers all such places as have been mentioned above, from the great partiality he has for fish. In procuring these, he displays, in a very singular manner, the genius and energy of his character, which is fierce, contemplative, daring, and tyrannical; attributes not exerted but on particular occasions; but when put forth, overpowering all opposition. Elevated on the high dead limb of some gigantic tree that commands a wide view of the neighbouring shore and ocean, he seems calmly to contemplate the motions of the various feathered tribes that pursue their busy avocations below; the snow-white gulls slowly winnowing the air; the busy *tringæ* (sandpipers) coursing along the sands; trains of ducks streaming over the surface; silent and watchful cranes, intent and wading; clamorous crows, and all the winged multitudes that subsist by the bounty of this vast liquid magazine of nature. High over all these hovers one whose action instantly arrests all his attention. By his wide curvature of wing, and sudden suspension in the air, he knows him to be the fish-hawk (*Pandion Haliætus*, Savigny,) settling over some devoted victim of the deep. His eye kindles at the sight, and balancing himself, with half-opened wings, on the branch, he watches the result. Down, rapid as an arrow from heaven, descends the distant object of his attention, the roar of its wings reaching the ear as it disappears in the deep, making the surge foam around. At this moment the eager looks of the eagle are all ardour; and levelling his neck for flight, he sees the fish-hawk once more emerge, struggling with his prey, and mounting in the air with screams of exultation. These are the signal for our hero, who, launching into the air, instantly gives chace, and soon gains on the fish-hawk; each exerts his utmost to mount above the other, displaying in the rencontre the most elegant and sublime aerial evolutions. The unincumbered eagle rapidly advances, and is just on the point of reaching his opponent, when with a sudden scream, probably of despair and honest execration, the latter drops his fish; the eagle, poising himself for a moment as if to take a more certain aim, descends like a whirlwind, snatches it in his grasp ere it reaches the water, and bears his ill-gotten booty silently away to the woods.

These predatory attacks and defensive manœuvres of the eagle and fish-hawk are matters of daily observation along the whole of our sea-board, from Georgia to New England, and frequently excite great interest in the spectators. Sympathy, however, on this as on most other occasions, generally sides with the honest and laborious sufferer, in opposition to the attacks of power, injustice, and rapacity, qualities for which our hero is so generally notorious, and which, in his superior, man, are equally detestable. As for the feelings of the poor fish, they seem altogether out of the question.—*Amer. Ornith.*

[2] This bird often presents a fine feature in the wild

The *erne :* a dirty iron colour above, an iron mixed with black below ; the head and neck ash, mixed with chestnut ; the points of the wings blackish ; the tail feathers white ; the legs naked.

The *black eagle :* blackish ; the head and upper neck mixed with red ; the tail feathers, the first half white, speckled with black ; the other half blackish ; the leg feathers dirty white.

The *sea eagle :* inclining to white, mixed with iron brown ; belly white with iron coloured spots ; the covert feathers of the tail whitish ; the tail feathers black at the extremity; the upper part of the leg feathers of an iron brown.[1]

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and desolate landscape. Its most favourite haunts in Britain are the northern coasts of Scotland, where the headlands reach a stupendous height, are perpendicular on the face, and where the shelves and ledges selected for a breeding or roosting place, can be tenanted secure from the inroads of an aggressor, either from above or beneath. Here he resides constantly at one season, or he finds a safe shelter during the night, after his more extended hunting excursions ; his screams scarcely sound above the noise of the surge below, or the storm which may rage around the rocky pinnacles ; but the occasional shriek heard in a moment of quiet, tells forcibly on the imagination while viewing such scenes, and the noble bird himself alone attracts the eye amidst the numerous sea-fowl his companions, his pale gray tinted plumage and pure outspread tail, being marked objects, when opposed to the dark green sea, or the deep and rich shades of many of these splendid precipices. In such situations the eyries are most frequently found, and the nest is there reared, and the young are hatched in safety, notwithstanding the bribes offered for their destruction. The nest is also sometimes placed in more inland sites. The precipitous crags overhanging some alpine loch are often chosen, and such is "Eagles' Craig," among the lakes of the English border, and the "Eagle's nest," at Killarney. Trees are also selected, though much less frequently. We visited a nest placed on an aged larch, growing on one of the romantic islands in Loch Awe. It was a large fabric of sticks placed about half way up the tree, (the nest of a sparrowhawk was a model of it in miniature,) built close to the stem, very flat, but strongly composed of sticks and roots, and lined in a very miscellaneous manner; wool formed the greatest part, moss also, and a child's bonnet, and a part of a bridle were in its structure. The eggs are generally two in number, larger than those of the golden eagle, round in form, and pure white, or with very pale indistinct blotches. In England the breeding places of the sea eagle are now very rare, perhaps not more than one or two. The birds themselves are, however, not unfrequently met with and shot, both in the south and in the border counties of Scotland, which are also beyond their breeding range ; but the greater part of the birds thus killed are in immature plumage.

From its occurrence in greatest numbers near the sea, or in the vicinity of some extensive piece of water, the commonly used name has been gained for this bird; but though delighting in fish, and often procuring this kind of food, we have no record by an eye-witness how the scaly prey is seized ; it is not a true fisher like the osprey, its structure is very different, and we have no authority for believing that it plunges. Its congener in America, we know, depends entirely on the prowess of another bird for the fish it procures, and is, moreover, very awkward in the attempts which it has been seen to make upon fish in their native element. But though fish is certainly the most favourite food, nothing seems to come far amiss; dead animals are sometimes even eaten, and he can be easily trapped by a bait of raw or newly killed meat. In confinement we have observed no nicety whatever, except in discriminating a fish from any other kind of food ; and a female which has been long in our possession, comes much more eagerly to the front of her cage, and appears more alert than usual when a trout is presented to her view.

The general colour of the plumage of the adult sea eagle is a chaste hair brown, of a peculiar dull or opaque tint; on the head and upper parts it is palest, the centre of the back and under parts being considerably darker; the head and upper part of the neck are covered with lanceolate shaped feathers, which are raised on excitement or irritation, and the tint here is remarkably clear, appearing at a distance, when shone on by the sun, almost white; the quills are blackish brown, with a purplish tinge, and have the shafts pale; the upper tail coverts and tail are pure white, and in all the attitudes of the bird are conspicuously seen. This mark of perfect plumage is considered to be completed about the third moult, but the female above alluded to had not a perfectly pure tail at the age of five years, the outer feathers retaining a considerable portion of the brown mottling, which is seen in the second year's plumage. Now, at the age of seven years, the tail is unsullied; the bill and cere are straw yellow, the latter of a darker, rather greener tint: the iris is remarkably beautiful, of a pale grayish honey yellow, very brilliant and expressive.

The plumage of the young bird, or cinereous eagle of authors, is generally of an umber brown, of a grayer tint beneath, the feathers tipped with a paler shade, and often white at the base; the tail is mottled with pale brownish white and clove brown, and with the successive moults the proportion of pale colour increases, prevailing most at the base and centre of the tail ; the colour of the bill is less clear, more mixed with green, and the iris is pale chestnut brown, but of a clear expression. The form of this species is less compact and firm than that of the golden eagle, and when at rest it appears more sluggish, from the greater coverts being brought forward and kept in a hanging position over the quills, covering the thighs and a portion of the side of the bird.—*Naturalist's Library, by Sir W. Jardine.*

[1] The sea-eagles form a less noble as well as a less typical group than the true eagles, from which they recede considerably both in organization and habits. The ridge of their beak, instead of being somewhat angular, is convex and compressed; and their legs, instead of being plumed down to the very toes, are naked in their lower parts, the upper half of the tarsi alone being covered with short close-set feathers. The cere in which the nostrils are perforated is slightly hispid; the wings are long and powerful; the anterior surface of the tarsi is scutellated ; the toes are free throughout their whole extent; the outer one is capable of taking a retroverted direction; and the claws are of unequal size, strongly curved, and furnished with a deep internal groove. They have all a greater or less tendency to change in a remarkable degree the colour of their plumage on the head and neck as they advance in age, evincing in this, as in several other respects, an approximation to certain South American groups, in which those parts are feathered in the young state and partially denuded in maturity, and through them to the vultures, in which the head and neck are in all stages of their growth covered only with a silky down.

In the choice of their food the sea-eagles are far less scrupulous than their brethren of the land. Inhabiting

The *osprey:* brown above, white below, the back of the head white, the outward tail feathers, on the inner side, streaked with white; legs naked.[1]

The *jean le blanc:* above, brownish grey: below, white, spotted with tawny brown; the tail feathers, on the outside and at the extremity, brown; on the inside, white, streaked with brown; legs naked.

The *eagle of Brazil:* blackish brown; ash colour, mixed in the wings; tail feathers white; legs naked. (See Plate XVI. fig. 6.)

The *Oroonoko eagle:* with a topping; above, blackish brown; below, white, spotted with black; upper neck yellow; tail feathers brown, with white circles; leg feathers white, spotted with black.

The *crowned African eagle:* with a topping; the tail of an ash colour, streaked on the upper side with black.

The *eagle of Pondicherry;* chestnut colour: the six outward tail feathers black one half.[2]

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most commonly the sea-coasts, or the banks of the large rivers and inlets, they make their prey chiefly of fishes and aquatic birds. These they usually carry off to devour at their leisure either on the rocks or in their nests. But occasionally, when all other resources fail, they fix themselves upon the dead carcasses of animals which are thrown upon the shore, and their manner of feeding under such circumstances closely resembles the disgusting voracity of the vultures. For hours and sometimes for days together they remain stationary upon the putrid carrion, and quit it only when it no longer affords the means of satiating the cravings of their appetite.

Much confusion has existed in the synonymy of the great sea-eagle, the difference of the colours of the plumage in the various stages of its growth, having misled authors so far as to induce them to record it under several distinct specific names. Three of these were almost universally admitted until about twenty years ago, when M. Frederic Cuvier published in the Annals of the French museum the result of his observations on the individuals confined in the Jardin des Plantes, which had convinced him of the propriety of uniting the falco ossifragus, albicaudus, and albicilla of Gmelin under one common name. The differences which were formerly supposed to exist between these birds have been recognised by almost every subsequent writer as those of age alone. In its earlier stages its beak is of a bluish horn-colour; its head and neck deep brown; the plumage of its upper surface brownish black, with a mixture of whitish or ash-coloured spots on the back and tail. In this state it is the falco ossifragus of systematic writers. As it advances in age, about the third or fourth year, the head and neck become of an ashy brown; the beak gradually loses its bluish tinge and changes to a pale yellow; the white spots on the back disappear; and the tail is of a uniform grayish white: this is the falco albicaudus of Gmelin, the petit pygargue of Buffon, and the lesser white-tailed eagle of Latham. When it has attained its fifth year the change may be regarded as complete: the head and neck have little of the brown tinge remaining; the back is throughout of a dusky brown intermixed with ashy gray; and the tail is perfectly white. It has now arrived at its mature state, in which it has been described and figured as the falco albicilla, the grand pygargue, and the white-tailed or cinereous eagle. In all its stages the cere and naked parts of the legs are yellow; the under part of the body is of a lighter hue than the upper, and more thickly interspersed with pale cinereous spots; and the claws are completely black.

The great sea-eagle is an inhabitant of nearly the whole of Europe and of Northern Asia. It sometimes builds its nests in the clefts of rocks, but more frequently on the summit of some lofty tree. The female lays two eggs, about the same size and shape as those of a goose. The young are fed with fish or flesh until they are able to quit the nest, when they sally forth with their parents in quest of their own prey, and speedily assume an independent mode of life.

With the sea-eagles of Europe and of the northern parts of America, are associated several other species of the eagle tribe, whose essential characters are nearly similar, and whose natural habits may therefore be presumed to be the same. Of these three are Asiatic, three African, two or three natives of Australia and the islands of the Polynesia, and two of South America; so that the group appears to be universally spread over all

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the grand divisions of the globe. The birds of which it is composed may be regarded as of almost equal utility in the economy of nature with the vultures, between which and the true eagles they hold an intermediate station. While the former are occupied in purifying the land from the putrid carcasses of beasts, the latter are busied in the performance of the same important office on the coasts and on the borders of lakes. They add moreover to these services the removal of the still more offensive remains of the fishes thrown upon the shore, which the vultures themselves, unless when hard pressed by hunger, would disdain to touch.—*Gardens and Menageries of the Zoological Society Delineated. Vol. II.*

[1] The *Osprey*, or *Ossifrage*, is so named, because fragments of bones of considerable magnitude have been found in its stomach. From its usual habitat on the



sea-shore, on the banks of great rivers and lakes over which it is continually hovering, it has received the denomination of the great sea-eagle; of which an account is given in the previous note.

[2] To these may be added, a species of sea-eagle, which M. Audubon has called the *Bird of Washington*, as being the noblest of the genus known to naturalists.

"It was on a winter's evening," he says, "in the month of February, 1814, that, for the first time in my life, I had an opportunity of seeing this rare and noble bird, and never shall I forget the delight it gave me. We were on a trading voyage, ascending the Upper Mississippi,—the keen winter blasts whistled over our heads, and the cold from which I suffered had, in a great degree, extinguished the deep interest which, at

CHAP. III.

THE CONDOR OF AMERICA.



We might now come to speak of the vulture kind, as they hold the next rank to the eagle; but we are interrupted in our method, by the consideration of an enormous bird, whose place is not yet ascertained; as naturalists are in doubt whether to refer it to the eagle tribe, or to that of the vulture. Its great strength, force and vivacity, might plead for its place among the former; the baldness of its head and neck might be thought to degrade it among the latter. In this uncertainty, it will be enough to describe the bird by the lights we have, and leave future historians to settle its rank in the feathered creation. Indeed, if size and strength, combined with rapidity of flight and rapacity, deserve pre-eminence, no bird can be put in competition with it.

The condor possesses, in a higher degree

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other seasons, this river has been wont to awake in me. I lay stretched beside our patroon; the safety of the cargo was forgotten, and the only thing that called forth my attention was the multitude of ducks, of different species, accompanied by vast flocks of swans, which from time to time would pass us. My patroon, a Canadian, had been engaged many years in the fur trade: he was a man of much intelligence, who, perceiving that these birds had engaged my curiosity, seemed only anxious to find some new object to divert me. The sea-eagle flew over us. 'How fortunate!' he exclaimed! 'this is what I could have wished. Look, sir! the great eagle, and the only one I have seen since I left the lakes.' I was instantly on my feet, and, having observed it attentively, concluded, as I lost it in the distance, that it was a species quite new to me.

"The sea-eagle of America is full one-fourth larger in size than any female specimen of the other kind I ever met with, old or young. In the United States, from Massachusetts to Louisiana on the seaboard, or as high as the mouth of the Missouri to the north-west, (I speak only of the extent of country I have visited, and where I have seen them,) these birds are very rare. This will appear to all, when I say that during my many long peregrinations more than eight or nine I never found, and only one nest. Two years had gone by since the discovery of the nest, in fruitless excursions; but my wishes were no longer to remain ungratified. In returning from the little village of Henderson, to the house of Dr R———, about a mile distant, I saw one rise from a small inclosure not a hundred yards before me, where the doctor had a few days before slaughtered some hogs, and alight upon a low tree branching over the road. I prepared my double-barrelled piece, which I constantly carry, and went slowly and cautiously towards him;—quite fearless, he awaited my approach, looking upon me with an undaunted eye. I fired, and he fell; before I reached him he was dead. With what delight I surveyed this magnificent bird! Had the finest salmon ever pleased him as he did me? Never. I ran and presented him to my friend. The doctor, who was an experienced hunter, examined the bird with much satisfaction, and frankly acknowledged he had never before seen or heard of it.

"The name I chose for this new species of eagle, 'The Bird of Washington,' may, by some, be considered as preposterous and unfit; but, being indisputably the noblest of the genus known to naturalists, I trust it will be allowed to retain it. To those, however, who may be curious to know my reasons, I can only say, that as the New World gave me birth and liberty, the great man who insured its independence is next to my heart: he had such true nobility of mind, and honest, generous feeling, as is seldom possessed. He was brave—so is the eagle; and his name, extending from pole to pole, resembles the majestic soarings of the mightiest of the feathered tribe.

"The flight of this bird is very different from that of the white-headed eagle, encircling more diameter than the latter;—whilst sailing, keeping nearer to the land and the surface of the water;—and when about to dive for fish, falling in a circuitous spiral manner, as if with an intention of checking all retreating movement which its prey might attempt, and only when within a few yards darting upon it. The fish-hawk often does the same. When rising with a fish, they fly to a considerable distance, forming, in their line of course and that of the water, a very acute angle, something not exceeding thirty degrees, when several hundred yards distant from the spot emerged from.

"The glands containing the oil used for the purpose of lubricating the surface of the plumage were, in the specimen here represented, extremely large; the contents had the appearance of hog's fat which had been melted and become rancid. This bird makes more copious use of that substance than the white-headed eagle, or any of the falco genus, except the fish-hawk;—the whole plumage looking, upon close examination, as if it had received a general coating of a thin, clear dilution of gum-arabic, and presenting less of the downy gloss exhibited on the upper part of the bald-headed eagle's plumage. The male bird weighs 14½ lbs. avoirdupois; measures 3 ft. 7 in. in length, and 10 ft. 2 in. in extent. The upper mandible 3⅜ in., dark bluish black: it is, however, the same colour for half its length, turning into yellow towards the mouth, which is surrounded with a thick yellow skin. Mouth, blue; tongue, the same; cere, greenish yellow; eye, large, of a fine chestnut colour; iris, black, the whole protected above by a broad, strong, bony, cartilaginous substance, giving the eye the appearance of being much sunk. Lores, lightish blue, with much strong recumbent hair; upper part of the head, neck, back, scapulars, rump, tail coverts, femorals, and tail feathers, dark, coppery, glossy brown; throat, front of the neck, breast, and belly, rich bright cinnamon colour;—the feathers of the whole of which are long, narrow, sharp-pointed, of a hairy texture, each dashed along the centre with the brown of the back; the wings, when closed, reach within an inch and a half of the end of the tail feathers, which are very broad next the body. Lesser coverts, rusty iron gray, forming with that colour an elongated oval, reaching from the shoulders to the lower end of the secondaries, gradually changing to the brown of the

than the eagle, all the qualities that render it formidable, not only to the feathered kind, but to beasts, and even to man himself. Acosta, Garcilasso, and Desmarchais, assert, that it is eighteen feet across, the wings extended. The beak is so strong as to pierce the body of a cow; and two of them are able to devour it. They do not even abstain from man himself: but fortunately there are but few of the species; for if they had been plenty, every order of animals must have carried on an unsuccessful war against them. The Indians assert, that they will carry off a deer, or a young calf, in their talons, as eagles would a hare or a rabbit; that their sight is piercing, and their air terrible; that they seldom frequent the forests, as they require a large space for the display of their wings; but that they are found on the sea-shore, and the banks of rivers, whither they descend from the heights of the mountains. By later accounts we learn, that they come down to the sea-shore only at certain seasons, when their prey happens to fail them upon land; that they then feed upon dead fish, and such other nutritious substances as the sea throws upon the shore. We are assured, however, that their countenance is not so terrible as the old writers have represented it; but that they appear of a milder nature than either the eagle or the vulture.

Condamine has frequently seen them in several parts of the mountains of Quito, and observed them hovering over a flock of sheep; and he thinks they would, at a certain time, have attempted to carry one off, had they not been scared away by the shepherds. Labat acquaints us, that those who have seen this animal, declare that the body is as large as that of a sheep; and that the flesh is tough, and as disagreeable as carrion. The Span-

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back as it meets the scapulars. The secondaries of the last middle tint. Primaries, brown, darkest in their inner veins, very broad and firm; the outer one two and a half inches shorter than the second; the longest twenty-four inches to its roots, and about half an inch in diameter at the barrel. The under wing coverts, iron gray, very broad, and forming the same cavity that is apparent in all this genus with the scapulars, which also are very broad. Legs and feet strong and muscular: the former one and a half inches in diameter; the latter measuring, from the base of the hind claw to that of the middle toe, six and a half inches. Claws strong, much hooked; the hind one two inches long, the inner rather less, all blue, black, and glossy. Toes warty, with rasp-like advancing hard particles, covered with large scales appearing again on the front of the leg, all of dirty strong yellow. Leg feathers brown cinnamon, pointed backwards.

"From the above account, it will be seen that the bird here described and faithfully figured from a fresh-killed specimen, is a very scarce species, even in those parts where it is a native; and, that it is rarely met with, the few opportunities I have had of seeing it, the dates of which I have generally given, are a sufficient proof."

The *Martial eagle*, sometimes called the *griffard*, is a large species discovered in Africa by Le Vaillant. It inhabits the country of the great Namaquois, between the twenty-eighth degree of south latitude and the tropic, and probably exists in the other parts of Africa. When perched, it emits sharp and piercing cries, mixed with hoarse and lugubrious tones, which are heard at a great distance. It flies, with the legs pendant, and, like the common eagle, rises so high that it is lost sight of, though its cry is still audible. Highly courageous, it never suffers any great bird of rapine to approach within its domain. It hunts gazelles and hares.

The griffards, like the other eagles, are usually observed in couples, but during the hatching time the male alone provides for the subsistence of the family. The nest is formed between precipitous rocks, or on the summits of lofty trees. Its basis is constituted like that of the other eagles' nests, but it is covered with a large quantity of small wood, moss, and roots, which give it a thickness of about two feet. This bed is again covered with small bits of dry wood, on which the female lays two eggs almost round, entirely white, and more than three inches in diameter.

The *Balbuzzard* is pretty generally spread through

France, Germany, and most of the countries of Europe from north to south. It is also found in Barbary, Egypt, Louisiana, and even in the island of Pins in the South Sea. The balbuzzards of the reeds in Carolina and Cayenne, appear to be only varieties of the same species, which equally inhabits Pennsylvania, and is sometimes called *piravera*. The places which the balbuzzard prefers to frequent, are not the shores of the sea, but low lands bordering on ponds and rivers, from which habit it might be termed the fresh-water eagle. Perched on a lofty tree, or hovering at a considerable elevation in the air, it watches the fish from afar, descends upon it with the rapidity of lightning, seizes it at the moment it appears on the surface of the water, or even plunges in completely after it, and carries it off in its talons. But this prey, the weight of which renders the flight of the bird slow and laborious, does not always remain the portion of the balbuzzard. On the banks of the Ohio, where it goes to fish, when the *perca ocellata* quits the ocean to enter the river, dwells also the formidable pygargus. When he sees the balbuzzard arrived to the height of his eyrie, he quits his own, pursues him closely, until the fisher, convinced of his inferiority, abandons the prey; then this fierce antagonist with folded wings shoots down like an arrow, and with the most inconceivable address, seizes the fish again before it reaches the river. The right of the strongest is the sovereign arbiter of small and great events, and governs throughout the universe with resistless sway, in the air, on the earth, and under the waters.

The *Great Harpy* (see Plate XVI. fig. 7.) is a bird which has been described under various synonyms, in consequence of the variations which result from age and sex, in its magnitude and plumage. It is found in Brazil, New Granada, and Guyana, where it particularly inhabits the forests of the interior. It is also found in other countries of America, and is peculiar to that continent. It is said to be the most robust and powerful of the feathered race. If the stories told of it be true, the benefits of nature seem, in this way, to be pretty equally distributed to both worlds. While the old can boast of the most terrible of quadrupeds, the fiercest and strongest of birds has fallen to the inheritance of the new. Travellers have assured Mauduyt, that the harpy makes its usual prey on the ai and the unau, and that it often carries off fawns and other young quadrupeds. It also attacks the arras, and the larger parrots.

The *Wedge-tailed eagle* (see Plate XVI. fig. 2.) may be regarded as the type of a distinct form in the impor-

iards themselves seem to dread its depredations; and there have been many instances of its carrying off their children.

Mr Strong, the master of a ship, as he was sailing along the coasts of Chili, in the thirty-third degree of south latitude, observed a bird sitting upon a high cliff near the shore, which some of the ship's company shot with a leaden bullet and killed. They were greatly surprised when they beheld its magnitude; for when the wings were extended, they measured thirteen feet from one tip to the other. One of the quills was two feet four inches long; and the barrel or hollow part, was six inches and three quarters, and an inch and a half in circumference.

We have a still more circumstantial account of this amazing bird, by P. Feuille, the only traveller who has accurately described it: "In the valley of Ilo, in Peru, I discovered a condor perched on a high rock before me: I approached within gun-shot, and fired; but as my piece was only charged with swan-shot, the lead was not able sufficiently to pierce the bird's feathers. I perceived however, by its manner of flying, that it was wounded; and it was with a good deal of difficulty that it flew to another rock, about five hundred yards distant on the sea-shore. I therefore charged again with ball, and hit the bird under the throat, which made it mine. I accordingly ran up to seize it; but even in death it was terrible, and defended itself upon its back with its claws extended against me, so that I scarcely knew how to lay hold of it. Had it not been mortally wounded, I should have found it no easy matter to take it; but I at last dragged it down from the rock, and with the assistance of one of the seamen, I carried it to my tent to make a coloured drawing.

"The wings of this bird, which I measured very exactly, were twelve feet three inches (English) from tip to tip. The great feathers, that were of a beautiful shining black, were two feet four inches long. The thickness of the beak was proportionable to the rest of the body; the length about four inches; the point hooked downwards, and white at its extremity; the other part was of a jet black. A short down of a brown colour, covered the head; the eyes were black, and surrounded with a circle of reddish brown. The feathers on the breast, neck, and wings, were of a light brown; those on the back were rather darker. Its thighs were covered with brown feathers to the knee. The thigh-bone was ten inches long; the leg five inches; the toes were three before, and one behind: that behind was an inch and a half: and the claw with which it was armed was black, and three quarters of an inch. The other claws were in the same proportion; and the legs were covered with black scales, as also the toes; but in these the scales were larger.

"These birds usually keep in the mountains, where they find their prey: they never descend to the sea-shore, but in the rainy season; for, as they are very sensible of cold, they go there for greater warmth. Though these mountains are situated in the torrid zone, the cold is often very severe; for a great part of the year, they are covered with snow, but particularly in winter.

"The little nourishment which these birds find on the sea-coast, except when the tempest drives in some great fish, obliges the condor to continue there but a short time. They usually come to the coast at the approach of evening; stay there all night, and fly back in the morning."

It is doubted whether this animal be proper to America only, or whether it may not have been described by the naturalists of other countries. It is supposed that the great bird called the Rock, described by Arabian writers, and so much exaggerated by fable, is but a species of the condor. The great bird of Tarnassar, in the East Indies, that is larger than the eagle, as well as the vulture of Senegal, that carries off children, are probably no other than the bird we have been describing. Russia, Lapland, and even Switzerland and Germany, are said to have known this animal. A bird of this kind was shot in France, that weighed eighteen pounds, and was said to be eighteen feet across the wings; however, one of the quills was described only as being larger than that of a swan; so that, probably, the breadth of the wings may have been exaggerated, since a bird so large would have the quills more than twice as big as those of a swan. However this be, we are not to regret that it is scarcely ever seen in Europe, as it appears to be one of the most formidable enemies of mankind. In the deserts of Pachomac, where it is chiefly seen, men seldom venture to travel. Those wild regions are very sufficient of themselves to inspire a secret horror: broken precipices — prowling panthers — forests only vocal with the hissing of serpents — and mountains rendered still more terrible by the condor, the only bird that ventures to make its residence in those deserted situations.[1]

tant family to which it belongs, agreeing with the genuine eagles of the old world in most points of its general structure, and more particularly in its lengthened wings and feathered legs, but differing from them in the character from which it derives its name. This form is peculiar to the continent of New Holland, where it appears exclusively to occupy the place of the even-tailed species of the European and Asiatic group, none of which have hitherto been detected on any part of the Australian coast.

[1] The preceding chapter shows how much ignorance

CHAP. IV.

OF THE VULTURE AND ITS AFFINITIES.

The first rank in the description of birds has been given to the eagle; not because it is stronger or larger than the vulture, but because it is more generous and bold. The eagle, unless pressed by famine, will not stoop to carrion; and never devours but what he has earned by his own pursuit. The vulture, on the contrary, is indelicately voracious; and seldom attacks living animals when it can be supplied with the dead. The eagle meets and singly opposes his enemy; the vulture, if it expects resistance, calls in the aid of its kind, and basely overpowers its prey by a cowardly combination. Putrefaction and stench, instead of deterring, only serves to allure them. The vulture seems among birds what the jackal and hyæna are among quadrupeds, who prey upon carcasses, and root up the dead.

Vultures may be easily distinguished from all those of the eagle kind, by the nakedness of their heads and necks, which are without feathers, and only covered with a very slight down, or a few scattered hairs. Their eyes are more prominent; those of the eagle being buried more in the socket. Their claws are shorter, and less hooked. The inside of the wing is covered with a thick down, which is different in them from all other birds of prey. Their attitude is not so upright as that of the eagle; and their flight is more difficult and heavy.

In this tribe we may range the golden, the ash-coloured, and the brown vulture, which are inhabitants of Europe; the spotted and the black vulture of Egypt; the bearded vulture; the Brazilian vulture, and the king of the vultures, of South America. They all

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prevailed regarding the condor up to a late period, and how much fable was interwoven with its history. Baron von Humboldt, the celebrated South American traveller, was the first to set before the world its true character. He passed seventeen months in the Andes, the native mountains of the condor; he saw the bird daily; he shot many specimens; and he is satisfied that in general their average size does not exceed that of the largest European vultures. The authentic history of the condor is, however, still full of interest. The eagle builds "his aery on the mountain top;" but the elevation at which the eagle lives is far inferior to the snowy peaks of the Andes, where the condor has his abiding place. At the extreme limit of vegetation, where all other animals perish, the condor prefers to dwell, inhaling an atmosphere so highly rarefied that almost every other creature would perish in it. From these immense elevations this wonderful bird soars still higher up, far above the clouds; and thence, with an almost unlimited range of sight, he surveys the earth. Scenting some carcase upon which he may banquet, he descends into the plains; and there he gorges himself with a voracity almost without example. Captain Head, in his 'Rough Notes,' has given an example of this habit of the condor:—"In riding along the plain I passed a dead horse, about which were forty or fifty condors: many of them were gorged and unable to fly; several were standing on the ground devouring the carcase—the rest hovering above it. I rode within twenty yards of them: one of the largest of the birds was standing with one foot on the ground and the other on the horse's body." He adds that one of his party had also ridden up to the dead horse; and as one of these enormous birds flew about fifty yards off, and was unable to go any farther, he rode up to him, and then, jumping off his horse, seized him by the neck. The man, who was a Cornish miner, said he had never had such a battle in his life, although he was at last the conqueror.

The condor does not exclusively feed upon dead or putrefying flesh; he attacks and destroys deer, vicunas, and other middling-sized or small quadrupeds. It is said, also, to be very common to see the cattle of the Indians, on the Andes, suffering from the severe wounds inflicted by these rapacious birds. It does not appear that they have ever attacked the human race. When Humboldt, accompanied by his friend Bonpland, was collecting plants near the limits of perpetual snow, they were daily in company with several condors which would suffer themselves to be quite closely approached without exhibiting signs of alarm, though they never showed any disposition to act offensively. They were not accused by the Indians of ever carrying off children, though frequent opportunities were presented, had they been so disposed. Humboldt believes that no authenticated case can be produced, in which the lammergeyer (or bearded vulture) of the Alps ever carried off a child, though so currently accused of such theft; but that the possibility of the evil has led to the belief of its actual existence.

The condor is not known to build a nest, but is said to deposit its eggs on the naked rocks. When hatched, the female is said to remain with the young for a whole year in order to provide them with food, and to teach them to supply themselves. In relation to all these points, satisfactory information still remains to be procured.

Humboldt saw the condor only in new Grenada, Quito, and Peru; but was informed that it follows the chain of the Andes, from the equator to the seventh degree of north latitude, into the province of Antioquia. There is now no doubt, says the Encyclopædia Americana, of its appearing even in Mexico, and the south-western territory of the United States.

The habits of the condor partake of the bold ferocity of the eagle, and of the disgusting filthiness of the vulture. Although, like the latter, it appears to prefer the dead carcass, it frequently makes war upon a living prey; but the gripe of its talons is not sufficiently firm to enable it to carry off its victim through the air. Two of these birds, acting in concert, will frequently attack a puma, a llama, a calf, or even a full grown cow. They will pursue the poor animal with unwearied pertinacity, lacerating it incessantly with their beaks and talons, until it falls exhausted with fatigue and loss of blood. Then, having first seized upon its tongue, they proceed to tear out its eyes, and commence their feast with these favourite morsels. The intestines form the second course of their banquet, which is usually continued until the birds have gorged themselves so fully as to render them incapable of using their wings in flight. The Indians, who are well acquainted with this effect of their voracity, are in the habit of turning it to account for their amusement in the chase. For this purpose

agree in their nature; being equally indolent, yet rapacious and unclean.[1]

The GOLDEN VULTURE seems to be the foremost of the kind; and is, in many things, like the golden eagle, but larger in every proportion. From the end of the beak to that of the tail, it is four feet and a half; and to the claws' end, forty-five inches. The length of

they expose the dead body of a horse or a cow, by which some of the condors, which are generally hovering in the air in search of food, are speedily attracted. As soon as the birds have glutted themselves on the carcass, the Indians make their appearance, armed with the lasso, and the condors, being unable to escape by flight, are pursued and caught by means of these singular weapons with the greatest certainty. This sport is a peculiar favourite in the country, where it is held in a degree of estimation second to that of a bull-fight alone.

[1] The great family of vultures is extensively spread throughout the globe, but especially abounds in the hotter latitudes, where their utility in removing carrion and all putrid animal substances, from the fields, the villages, and even the towns, has been universally acknowledged.

As we recede from the hotter climes to the more temperate regions, we gradually lose the presence of the vultures, till at length the boundaries of the race are passed. Their extreme boundaries, however, are more northerly, or rather are carried out more nearly to the higher latitudes of the globe than might at first be suspected. In America the turkey vulture (*cathartes aura*) ranges from Terra del Fuego to Nova Scotia, and the black vulture (*cathartes atratatus*) is common in Carolina. Species are found in southern and central Europe, without reckoning the lammer-geyer (*gypætos berbatus*) which forms a connecting link between the timid, indolent, and gluttonous vultures on the one hand, and the fierce, rapacious eagles on the other, we may enumerate the *vultur cinereus* and the griffon, or *vultur fulvus*, both of which occur in the mountain chains of even central Europe, and are tolerably common in the southern districts, being spread over most parts of the old world. To these we may add the Egyptian vulture, or Pharaoh's chicken (*neophron percnopterus*.)

The genus *neophron* may be regarded as equivalent in the old world to *cathartes* in the new, the Egyptian vulture closely approximating in form, habits, and relatively in the range of its habitat to the turkey vulture. Of the vulture of the old world the Egyptian vulture is the smallest; it is however one of the most numerous, and especially abounds in Egypt and the adjacent provinces of Europe, Asia, and Africa; it has even been seen in Italy and Switzerland, and on one occasion in England. In temperate climates, birds that prey on carrion are less necessary as scavengers than in tropical countries, where flocks of vultures collect together from distances that have astonished all observers by whom the circumstance is recorded. This is well exemplified in two species, which have been frequently confounded, the turkey buzzard and the black vulture, both of which are looked upon as so useful in several of the States both of North and South America, that there is a considerable penalty for killing them. The former bird, indeed, as we learn from M. Descourtilz, is, at Charleston, commonly called by the name of *five pounds*, from the amount of this penalty. "These birds," he adds, "are thus respected for the actual services which they render in removing from the city and its vicinity all dead animals and other garbage upon which they exclusively feed. Hence, if even a chicken die, it is not long before its bones are picked clean. The vultures are occupied the whole day in making their rounds to discover carrion and offal, and coming down in legions, they mutually contend for the prey, which instantly disappears. They are so familiar that they may easily be knocked down with a stick. I had a great desire to procure a specimen in this way; but I was not disposed to pay five louis-d' or

of penalty." "The great number of these birds" (*the black vulture,*) says Ulloa, "found in such hot climates, is an excellent provision of nature; as otherwise the putrifaction caused by the constant and excessive heat would render the air insupportable to human life. These birds are familiar in Carthagena; the tops of the houses are covered with them: it is they who cleanse the city of all its animal impurities. There are few animals killed whereof they do not obtain the offals; and when this food is wanting, they have recourse to other garbage. Their sense of smelling is so acute, that it enables them to trace carrion at the distance of three or four leagues; which they do not abandon till there remains nothing but the skeleton." The following account of the same bird is by Wilson.

"A horse had dropped down in the street in convulsions, and dying, it was dragged out to Hampstead and skinned. The ground for a hundred yards around it was black with carrion crows; many sat on the tops of sheds, fences, and houses within sight; sixty or eighty on the opposite side of a small run. I counted at one time two hundred and thirty-seven, but I believe there were more, besides several in the air over my head and at a distance. I ventured cautiously within thirty yards of the carcass, where three or four dogs and twenty or thirty vultures were busily tearing and devouring. Seeing them take no notice I ventured nearer, till I was within ten yards, and sat down on the bank. Still they paid little attention to me. The dogs being sometimes accidentally flapped with the wings of the vultures, would growl and snap at them, which would occasion them to spring up for a moment, but they immediately gathered in again. I remarked that the vultures frequently attack each other, fighting with their claws or heels, striking like a cock, with open wings, and fixing their claws in each other's head. The females, and I believe the males likewise, made a hissing sound, with open mouth, exactly resembling that produced by thrusting a red-hot poker into water; and frequently a snuffling, like a dog clearing his nostrils, as, I suppose, they were theirs. On observing that they did not heed me, I stole so close that my feet were within one yard of the horse's legs, and again sat down. They all slid aloof a few feet; but seeing me quiet, they soon returned as before. As they were often disturbed by the dogs, I ordered the latter home: my voice gave no alarm to the vultures. As soon as the dogs departed, the vultures crowded in such numbers, that I counted at one time thirty-seven on and around the carcass, with several within; so that scarcely an inch of it was visible. Sometimes one would come out with a large piece of the entrails, which in a moment was surrounded by several others, who tore it in fragments, and it soon disappeared. They kept up the hissing occasionally. Some of them having their whole legs and heads covered with blood presented a most savage aspect. Still, as the dogs advanced, I would order them away, which seemed to gratify the vultures; and one would pursue another to within a foot or two of the spot where I was sitting. Sometimes I observed them stretching their necks along the ground, as if to press the food downwards." The black vulture appears to be the same bird which is described by Acosta, under the name of *paullazes*. As he tells us, "they have a surprising agility and a piercing eye, and are very useful for clearing cities, not suffering the least vestige of carrion or putrid matter to remain. They spend the night upon trees and rocks, and resort to the towns in the morning, perching upon the tops of the highest buildings, whence they look out for their plunder."

the upper mandible is almost seven inches; and the tail twenty-seven in length. The lower part of the neck, breast, and belly, are of a red colour; but on the tail it is more faint, and deeper near the head. The feathers are black on the back; and on the wings and tail of a yellowish brown. Others of the kind differ from this in colour and dimensions; but they are all strongly marked by their naked heads, and beak, straight in the beginning, but hooking at the point.

They are still more strongly marked by their nature, which, as has been observed, is cruel, unclean, and indolent. Their sense of smelling, however, is amazingly great; and Nature, for this purpose, has given them two large apertures or nostrils without, and an extensive olfactory membrane within.[1] Their intestines are formed differently from those of the eagle kind; for they partake more of the formation of such birds as live upon grain. They have both a crop and a stomach; which may be regarded as a kind of gizzard, from the extreme thickness of the muscles of which it is composed. In fact, they seem adapted inwardly, not only for being carnivorous, but to eat corn or whatsoever of that kind comes in the way.

This bird, which is common in many parts of Europe, and but too well known on the western continent, is totally unknown in England. In Egypt, Arabia, and many other kingdoms of Africa and Asia, vultures are found in great abundance. The inside down of their wing is converted into a very warm and comfortable kind of fur, and is commonly sold in the Asiatic markets.

Indeed, in Egypt, this bird seems to be of singular service. There are great flocks of them in the neighbourhood of Grand Cairo, which no person is permitted to destroy. The service they render the inhabitants is the devouring of all the carrion and filth of that great city; which might otherwise tend to corrupt and putrefy the air. They are commonly seen in company with the wild dogs of the country, tearing a carcase very deliberately together. This old association produced no quarrels; the birds and quadrupeds seem to live amicably, and nothing but harmony subsists between them. The wonder is still the greater, as both are extremely rapacious, and both lean and bony to a very great degree; probably having no great plenty even of the wretched food on which they subsist.

In America they lead a life somewhat similar. Wherever the hunters, who there only pursue beasts for the skins, are found to go, these birds are seen to pursue them. They still keep hovering at a little distance; and

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In the plates we have given representations of several vultures. Fig. 1. plate XV. represents the Griffon Vulture, one of the largest birds of prey of the old continent, measuring from 3½ to 4 feet in length. It inhabits the mountain chains of Europe, Asia, and Africa. Fig. 1. plate XVI. represents the King of the vultures, described in the text. Fig. 9. represents the Bearded Vulture, a bird which seems to form a link between the vulture and the eagle, as it seeks living prey as well as carrion. It is the Lemmergeyer of the Swiss and German Alps, and the largest European bird of prey, measuring upwards of four feet from beak to tail, and nine or ten in the expanse of its wings. Fig. 3. same plate, represents the Secretary Vulture, so called from the pen-like appendage behind the ear.

[1] Is it by the powers of sight or of smell that these birds, afar off in the air above, or on the very verge of the horizon, are thus led to their booty? This is a question not yet settled. The ancient classic writers teem with passages attributing to the vulture a keen and discriminating scent; and certainly the development of the organs of this sense would seem to favour the opinion, which is supported by Mr Waterton and others, but which Mr Audubon considers to be erroneous. This latter observer of Nature maintains that it is by the extraordinary powers of sight that the vulture perceives his prey, and Le Vaillant explains the circumstance upon the same theory. "Desirous," he says, "of observing how so great a number of vultures could congregate together in so short a space of time, I concealed myself one day in a thicket, after having killed a large gazelle, which I left upon the spot. In an instant a number of ravens made their appearance, fluttering about the animal, and making a great croaking. In less than a quarter of an hour these birds were reinforced by the arrival of kites and buzzards; and immediately afterwards I perceived, on raising my head, a flight of birds at a prodigious height, wheeling round and round in their descent. These I soon recognised to be vultures, which seemed, if I may so express myself, to escape from a cavern in the sky. The first comers fell immediately upon the gazelle, but I did not allow them time to tear it in pieces. I left my concealment, and they betook themselves slowly and heavily to flight, rejoining their comrades, whose numbers seemed to increase. They seemed almost to precipitate themselves from the clouds to share the spoil, but my presence caused them speedily to disappear. Thus it is then, that the vultures are called upon to participate in their prey:—the first carnivorous birds that discover a carcase rouse the others which may happen to be in the environs by their cries and by their motions. If the nearest vulture does not spy his prey from the lofty region of the air in which he swims by means of his wide-spread wings, he perceives at least the subaltern and more terrestrial birds of prey preparing to take possession of it; but perhaps he has himself a sufficient power of vision to enable him to discover it. He descends hastily and with a wheeling flight, and his fall directs the other vultures who witness his evolutions, and who no doubt have their instinct sharpened with regard to everything that concerns their food. A concourse of carnivorous birds speedily takes place in the neighbourhood of the carcass sufficient to attract the vultures of the whole district, nearly in the same manner as the disturbance created by a number of men running along the streets of a crowded town attracts the whole population to follow in their train." Notwithstanding all this, and the experiments of Mr Audubon, we do not think the conclusion by any means demonstrated, that the vulture is not guided by his scent, as well as by his powers of vision, according as the case may be.

when they see the beast flayed and abandoned, they call out to each other, pour down upon the carcase, and, in an instant, pick its bones as bare and clean as if they had been scraped by a knife.

At the Cape of Good Hope, in Africa, they seem to discover a still greater share of dexterity in their methods of carving. "I have," says Kolben, "been often a spectator of the manner in which they have anatomized a dead body: I say anatomized; for no artist in the world could have done it more cleanly. They have a wonderful method of separating the flesh from the bones, and yet leaving the skin quite entire. Upon coming near the carcass, one would not suppose it thus deprived of its internal substance, till he began to examine it more closely; he then finds it, literally speaking, nothing but skin and bone. Their manner of performing the operation is this: they first make an opening in the belly of the animal, from whence they pluck out, and greedily devour, the entrails: then entering into the hollow which they have made, they separate the flesh from the bones, without ever touching the skin. It often happens that an ox returning home alone to its stall from the plough, lies down by the way; it is then, if the vultures perceive it, that they fall with fury down, and inevitably devour the unfortunate animal. They sometimes attack them grazing in the fields; and then to the number of a hundred or more, make their attack all at once and together."

"They are attracted by carrion," says Catesby, "from a very great distance. It is pleasant to behold them, when they are thus eating and disputing for their prey. An eagle generally presides at these entertainments, and makes them all keep their distance till he has done. They then fall to with an excellent appetite; and their sense of smelling is so exquisite, that the instant a carcass drops, we may see the vultures floating in the air from all quarters, and come sousing on their prey." It is supposed by some, that they eat nothing that has life; but this is only when they are not able; for when they come at lambs, they show no mercy; and serpents are their ordinary food. The manner of those birds is to perch themselves, several together, on the old pine and cypress-trees; where they continue all the morning, for several hours, with their wings unfolded; nor are they fearful of danger, but suffer people to approach them very near, particularly when they are eating.

The sloth, the filth, and the voraciousness, of these birds, almost exceeds credibility. In the Brazils, where they are found in great abundance, when they light upon a carcass, which they have liberty to tear at their ease, they so gorge themselves that they are unable to fly; but keep hopping along when they are pursued. At all times, they are a bird of slow flight, and unable readily to raise themselves from the ground; but when they have over-fed, they are then utterly helpless; but they soon get rid of their burden; for they have a method of vomiting up what they have eaten, and then they fly off with greater facility.

It is pleasant, however, to be a spectator of the hostilities between animals that are thus hateful or noxious. Of all creatures, the two most at enmity is the vulture of Brazil and the crocodile. The female of this terrible amphibious creature, which in the rivers of that part of the world grows to the size of twenty-seven feet, lays its eggs, to the number of one or two hundred, in the sands, on the side of the river, where they are hatched by the heat of the climate. For this purpose, she takes every precaution to hide from all other animals the place where she deposits her burden: in the mean time a number of vultures, or galinassos, as the Spaniards call them, sit silent and unseen in the branches of some neighbouring forest, and view the crocodile's operations, with the pleasing expectation of succeeding plunder. They patiently wait till the crocodile has laid the whole number of her eggs, till she has covered them carefully under the sand, and until she is retired from them to a convenient distance. Then, all together encouraging each other with cries, they pour down upon the nest, hook up the sand in a moment, lay the eggs bare, and devour the whole brood without remorse. Wretched as is the flesh of these animals, yet men, perhaps when pressed by hunger, have been tempted to taste it. Nothing can be more lean, stringy, nauseous, and unsavoury. It is in vain that, when killed, the rump has been cut off; in vain the body has been washed, and spices used to overpower its prevailing odour; it still smells and tastes of the carrion by which it was nourished, and sends forth a stench that is insupportable.

These birds, at least those of Europe, usually lay two eggs at a time, and produce but once a year. They make their nests in inaccessible cliffs, and in places so remote, that it is rare to find them. Those in our part of the world chiefly reside in the places where they breed, and seldom come down into the plains, except when the snow and ice, in the native retreats, has banished all living animals but themselves: they then come from their heights, and brave the perils they must encounter in a more cultivated region. As carrion is not found, at those seasons, in sufficient quantity, or sufficiently remote from man to sustain them, they prey upon rabbits, hares, serpents,

and whatever small game they can overtake or overpower.

Such are the manners of this bird in general; but there is one of the kind, called the king of the vultures, (See Plate XVI. fig. 1.) which from its extraordinary figure, deserves a separate description. This bird is a native of America, and not of the East Indies, as those who make a trade of showing birds would induce us to believe. This bird is larger than a turkey-cock; but is chiefly remarkable for the odd formation of the skin of the head and neck, which is bare. This skin arises from the base of the bill, and is of an orange colour; from whence it stretches on each side to the head; from thence it proceeds, like an indented comb, and falls on either side, according to the motion of the head. The eyes are surrounded by a red skin, of a scarlet colour; and the iris has the colour and lustre of pearl. The head and neck are without feathers, covered with a flesh-coloured skin on the upper part, a fine scarlet behind the head, and a duskier coloured skin before: farther down, behind the head, arises a little tuft of black down, from whence issues and extends beneath the throat, on each side, a wrinkled skin, of a brownish colour, mixed with blue, and reddish behind; below, upon the naked part of the neck, is a collar formed by soft longish feathers, of a deep ash-colour, which surround the neck, and cover the breast before. Into this collar the bird sometimes withdraws its whole neck, and sometimes a part of its head, so that it looks as if it had withdrawn the neck into the body. Those marks are sufficient to distinguish this bird from all others of the vulture kind; and it cannot be doubted, but that it is the most beautiful of all this deformed family; however, neither its habits nor instincts vary from the rest of the tribe; being, like them, a slow cowardly bird, living chiefly upon rats, lizards, and serpents; and upon carrion or excrement, when it happens to be in the way. The flesh is so bad, that even savages themselves cannot abide it.

CHAP. V.

OF THE FALCON KIND, AND ITS AFFINITIES.

Every creature becomes more important in the history of nature in proportion as it is connected with man. In this view, the smallest vegetable, or the most seemingly contemptible insect, is a subject more deserving attention than the most flourishing tree, or the most beautiful of the feathered creation. In this view, the falcon is a more important animal than the eagle or the vulture; and though so very diminutive in the comparison, is notwithstanding, from its connection with our pleasures, a much more interesting object of curiosity.

The amusement of hawking, indeed, is now pretty much given over in this kingdom; for as every country refines, as its enclosures become higher and closer, those rural sports must consequently decline, in which the game is to be pursued over a long extent of country; and where, while every thing retards the pursuer below, nothing can stop the object of his pursuit above.[1]

Falconry, that is now so much disused among us, was the principal amusement of our ancestors. A person of rank scarcely stirred out without his hawk on his hand; which, in old paintings, is the criterion of nobility. Harold, afterwards king of England, when he went on a most important embassy into Normandy, is drawn in an old bas-relief, as embarking with a bird on his fist, and a dog under his arm.[2] In those days it was thought sufficient for noblemen's sons to wind the horn, and to carry their hawk fair, and leave study and learning to the children of meaner people. Indeed, this diversion was in such high esteem among the great all over Europe, that Frederic, one of the emperors of Germany, thought it not beneath him to write a treatise upon hawking.

The expense which attended this sport was very great: among the old Welch princes, the king's falconer was the fourth officer in the state; but notwithstanding all his honours, he was forbid to take more than three draughts of beer from his horn, lest he should get drunk and neglect his duty. In the reign of James

[1] The introduction of fire-arms was the main cause of the decline of falconry. We still think, however, that, as a field sport, hawking must have been much more interesting than any at present in practice.

[2] The ancient books of hawking assign to the different ranks of persons the sort of hawk proper to be used by them; and they are placed in the following order:

The eagle, the vulture, and the merloun, for an emperor.
The gyr-falcon, and the tercel of the gyr-falcon for a king.
The falcon gentle and the tercel gentle, for a prince.
The falcon of the rock, for a duke.
The falcon peregrine, for an earl.
The bastard, for a baron.
The sacre, and the sacret, for a knight.
The lanere, and the laneret, for an esquire.
The marlyon, for a lady.
The hobby, for a young man.
The goshawk, for a yeoman.
The tercel, for a poor man.
The sparrow-hawk, for a priest.
The musket for a holy water clerk.
The kesterel, for a knave or servant.

And this list includes, I presume, the greater part, if not all, of the names appertaining to the birds used in hawking.—*Strutt's Sports and Pastimes.*

I. Sir Thomas Monson is said to have given a thousand pounds for a cast of hawks; and such was their value in general, that it was made felony in the reign of Edward III. to steal a hawk. To take its eggs, even in a person's own ground, was punishable with imprisonment for a year and a day, together with a fine at the king's pleasure. In the reign of Elizabeth the imprisonment was reduced to three months; but the offender was to lie in prison till he got security for his good behaviour for seven years farther. In the earlier times the art of gunning was but little practised, and the hawk was then valuable, not only for its affording diversion, but for its procuring delicacies for the table, that could seldom be obtained any other way.

Of many of the ancient falcons used for this purpose, we at this time know only the names, as the exact species are so ill described, that one may be very easily mistaken for another. Of those in use, at present, both here and in other countries, are the gyr-falcon, the falcon, the lanner, the sacre, the hobby, the kestrel, and the merlin. These are called the long-winged hawks, to distinguish them from the goshawk, the sparrow-hawk, the kite, and the buzzard, that are of shorter wing, and either too slow, too cowardly, too indolent, or too obstinate, to be serviceable in contributing to the pleasures of the field.[1]

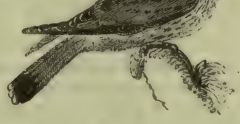
The generous tribe of hawks, as was said, are distinguished from the rest by the peculiar length of their wings, which reach nearly as low as the tail. In these, the first quill of the wing is nearly as long as the second; it

[1] The *Jer Falcon* (see Plate XV. fig. 3.) is of very rare occurrence in England. It is known in the northern parts of Scotland, particularly in the Orkney and Shetland Isles. Iceland is the native country of this species, from whence arises its name of Islandicus. It was from this island that the royal falconries of Denmark and other northern kingdoms were supplied with their choicest casts of hawks. It breeds in the highest and most inaccessible rocks; but the number and colour of the eggs remain as yet undescribed. It preys upon the larger species of game and wild-fowl, also on hares and other quadrupeds, upon which it precipitates itself with amazing rapidity and force. Its usual mode of hawking is, if possible, to out-soar its prey, and thence to dart perpendicularly upon it.

The uncertainty in which the history of the *Peregrine Falcon* was long involved, appears to have arisen from the error of earlier writers, in considering the *Falco Peregrinus* and *Falco Communis*, with its enumerated varieties, as two distinct species. Deficiency of observation, and consequent want of an accurate knowledge of the various changes of plumage the bird undergoes in its progress to maturity, naturally led to this effect; and we accordingly find, that the bird hitherto described as the *Falco Communis*, the type of the supposed species and its varieties, must have been originally figured from an immature specimen of the *Falco Peregrinus*. In England and Wales the peregrine falcon is rare, and is only found indigenous in rocky or mountainous districts. The Highlands and northern isles of Scotland appear to be the situations most favourable to it, and in that part of the kingdom it is numerous and widely diffused. The most inaccessible situations are always selected for its eyry, and its nest is placed upon the shelf of a rock. It lays four or five eggs, in colour very similar to those of the kestrel, but considerably larger. The flight of this species, when pursuing its quarry, is astonishingly rapid, almost beyond credibility. By Montagu it has been reckoned at 150 miles in an hour. Colonel Thornton, an expert falconer, estimated the flight of a falcon, in pursuit of a snipe, to have been nine miles in eleven minutes, without including the frequent turns. This sort was formerly much used in falconry, and was flown at the larger kinds of game, wild ducks and herons. In its unreclaimed state it preys upon the different sorts of game, wild geese, wild ducks and pigeons.

In England, the *Hobby* is among the number of those birds that are named polar migrants or summer periodical visitants. It arrives in April, and after performing the office of incubation, and of rearing its young, leaves us, for warmer latitudes, in October. Wooded and inclosed districts appear to be its usual haunts. It builds in lofty trees, but will sometimes save itself the task of constructing a nest, by taking possession of the deserted one of a magpie or crow. The number of its eggs is commonly four, of a bluish-white, with olive-green or yellowish-brown blotches. Its favourite game is the lark, but it preys upon all small birds. Partridges and quails also become frequent victims to its courage and rapacity, in which qualities, diminutive as it is, it yields to none of its tribe. Possessing a great length and power of wing, the flight of the hobby is wonderfully rapid, and can be supported with undiminished vigour for a considerable time. When hawking was keenly followed, the hobby was trained to the pursuit of young partridges, snipes, and larks. It is of elegant form, and resembles, in miniature, the peregrine falcon. The wings, when closed, generally reach beyond the end of the tail. According to Temminck, it is common throughout Europe, during the summer months; but retires to warmer regions at the approach of winter.

Kestrel.—This well known species is distinguished, not only by the symmetry of its form and its elegant



plumage, but by the peculiar gracefulness of its flight, and the manner in which it frequently remains suspended in the air, fixed, as it were, to one spot by a quivering play of the wings, scarcely perceptible. It is one of our commonest indigenous species, and is widely spread through the kingdom. Upon the approach of spring (or the period of incubation), it resorts to rocks and high cliffs. The nest consists of a few sticks loosely put together, and sometimes lined with a little hay or wool, and is placed in some crevice, or on a projecting shelf. The eggs are from four to six in number, of a reddish-brown colour, with darker blotches and variegations. It preys upon the different species of mice, which it hunts for from the elevated station at which it usually soars, and upon which it pounces with the rapidity of an arrow. The kestrel is easily reclaimed, and was formerly trained to the pursuit of larks, snipes, and young partridges. It is a species, in point of geographical distri

terminates in a point, which begins to diminish from about an inch of its extremity. This sufficiently distinguishes the generous breed from that of the baser race of kites, sparrow-hawks and buzzards, in which the tail is longer than the wings, and the first feather of the wing is rounded at the extremity. They differ also in the latter having the fourth feather of the wing the longest; in the generous race it is always the second.

This generous race, which have been taken into the service of man, are endowed with natural powers that the other kinds are not possessed of. From the length of their wings, they are swifter to pursue their game; from a confidence in this swiftness, they are bolder to attack it; and from an innate generosity, they have an attachment to their feeder, and, consequently, a docility which the baser kinds are strangers to.

The gyr-falcon leads in this bold train. He exceeds all other falcons in the largeness of his size, for he approaches nearly to the magnitude of the eagle. The top of the head is flat and of an ash-colour, with a strong, thick, short, and blue beak. The feathers of the back and wings are marked with black spots, in the shape of a heart; he is a courageous and fierce bird, nor fears even the eagle himself; but he chiefly flies at the stork, the heron, and the crane. He is mostly found in the colder regions of the north, but loses neither his strength nor his courage when brought into the milder climates.

The falcon, properly so called, is the second in magnitude and fame. There are some varieties in this bird; but there seem to be only two that claim distinction; the falcon-gentil and the peregrine-falcon; both are much less than the gyr, and somewhat about the size of a raven. They differ but slightly, and perhaps only from the different states they were in when brought into captivity. Those differences are easier known by experience than taught by description. The falcon-gentil[1] moults in March, and often sooner; the

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bution, very widely spread, being found in all parts of Europe, and in America.

The *Merlin* has generally been considered a winter or equatorial visitant, and to leave Great Britain at the



approach of spring, for other and more northern climates. Its migration is however confined to the southern parts of the island. Inferior as this species is in size, it fully supports the character of its tribe; frequently attacking birds superior to itself in magnitude and weight, and has been known to kill a partridge at a single blow. Like others, before enumerated, it became subjected to the purposes of pastime, and was trained to pursue partridges, snipes, and woodcocks. Its flight is low and rapid, and it is generally seen skimming along the sides of hedges in search of its prey.

The *Goshawk.* (See Plate XVI. fig. 13: for swallow-tailed hawk, see fig. 12.) This powerful species of falcon is very rarely met with in England. In the wild and mountainous districts of Scotland it is more common, and is known to breed in the forest of Rothiemurchus, and on the wooded banks of the Dee; and, according to Low, in his Fauna Orcadensis, is rather numerous in those islands (Orkneys), where it breeds in the rocks and sea-cliffs. Its flight is very rapid, but generally low, and it strikes its prey upon the wing. Different kinds of feathered game, wild ducks, hares and rabbits form its principal food. According to Meyer, it will even prey upon the young of its own species. It generally builds in lofty fir trees, and lays from two to four eggs, of a skim-milk white, marked with streaks and spots of reddish-brown. By falconers, it was considered to be the best and most courageous of the short-winged hawks, and was accordingly trained to the pursuit of grouse, pheasants, wild geese, herons, &c. Although it is nearly equal in size to the jer falcon, yet the shortness of its wings, and its general contour, readily distinguish it from that species, in all its stages of plumage. The goshawk is very common in France, as well as in Germany, Switzerland, and Russia. In Holland it is rare. The "*falcon gentil,*" from its description, must be referred to this species.

The Sparrow-hawk.—This destructive and well-known species is remarkable for the great difference in size between the male and female, the former seldom measur-



ing twelve inches in length, whilst the latter often exceeds fifteen inches. It is one of the boldest of its genus, and the female, from her superior size, is a fatal enemy to partridges and other game, as well as pigeons. It flies low, skimming over the ground with great swiftness, and pounces its prey upon the wing with unerring aim. The force of its stroke is such as generally to kill, and sometimes even to force out the entrails of its victim. It is common in most parts of the kingdom, but particularly frequents the lower grounds, and well-wooded inclosures. It builds in low trees, or thorn bushes, forming a shallow and flat nest, composed of slender twigs, and very similar to that of the ring dove, but rather larger. It will occasionally occupy the deserted nest of a crow. The sparrow-hawk is very widely diffused and found in all parts of Europe. In the days of falconry it was trained, and much approved in the pursuit of partridges, quails, and many other birds.—*Abridged from Selby's Illustrations of British Ornithology.*

[1] The falcons gentil are now ascertained to be merely the young of the goshawk.

peregrine-falcon does not moult till the middle of August. The peregrine is stronger in the shoulder, has a larger eye, and yet more sunk in the head; his beak is stronger, his legs longer, and the toes better divided.

Next in size to these is the lanner, a bird now very little known in Europe; then follows the sacre, the legs of which are of a bluish colour, and serve to distinguish that bird; to them succeeds the hobby, used for smaller game, for daring larks, and stooping at quails. The kestril was trained for the same purposes; and lastly the merlin; which, though the smallest of all the hawk or falcon kind, and not much larger than a thrush, yet displays a degree of courage that renders him formidable even to birds ten times his size. He has often been known to kill a partridge or a quail at a single pounce from above.

Some of the other species of sluggish birds were now and then trained to this sport, but it was when no better could be obtained; but these just described were only considered as birds of the nobler races. Their courage in general was such, that no bird, not very much above their own size, could terrify them; their swiftness so great, that scarcely any bird could escape them; and their docility so remarkable, that they obeyed not only the commands, but the signs of their master. They remained quietly perched upon his hand till their game was flushed, or else kept hovering round his head, without ever leaving him but when he gave permission. The common falcon is a bird of such spirit, that, like a conqueror in a country, he keeps all birds in awe and subjection to his prowess. Where he is seen flying wild, as I often had an opportunity of observing, the birds of every kind, that seemed entirely to disregard the kite or the sparrow-hawk, fly with screams at his most distant appearance. Long before I could see the falcon, I have seen them with the utmost signs of terror endeavouring to avoid him; and, like the peasants of a country before a victorious army, every one of them attempting to shift for himself. Even the young falcons, though their spirit be depressed by captivity, will, when brought out into the field, venture to fly at barnacles and wild geese, till, being soundly brushed and beaten by those strong birds, they learn their error, and desist from meddling with such unwieldly game for the future.

To train up the hawk to this kind of obedience, so as to hunt for his master, and bring him the game he shall kill, requires no small degree of skill and assiduity. Numberless treatises have been written upon this subject which are now, with the sport itself, almost utterly forgotten: indeed, except to a few, they seem utterly unintelligible; for the falconers had a language peculiar to themselves, in which they conversed and wrote, and took a kind of professional pride in using no other. A modern reader, I suppose, would be little edified by one of the instructions, for instance, which we find in Willoughby, when he bids us "draw our falcon out of the mew twenty days before we enseam her. If she truss and carry, the remedy is, to cosse her talons, her powse, and petty single."

But, as it certainly makes a part of natural history, to show how much the nature of birds can be wrought upon by harsh or kind treatment, I will just take leave to give a short account of the manner of training a hawk, divested of those cant words with which men of art have thought proper to obscure their profession.

In order to train up a falcon, the master begins by clapping straps upon his legs, which are called *jesses*, to which there is fastened a ring with the owner's name, by which, in case he should be lost, the finder may know where to bring him back. To these also are added little bells, which serve to mark the place where he is, if lost in the chase. He is always carried on the fist, and is obliged to keep without sleeping. If he be stubborn, and attempts to bite, his head is plunged into water. Thus, by hunger, watching, and fatigue, he is constrained to submit to having his head covered by a hood or cowl, which covers his eyes. This troublesome employment continues often for three days and nights without ceasing. It rarely happens but at the end of this his necessities and the privation of light make him lose all idea of liberty, and bring down his natural wildness. His master judges of his being tamed when he permits his head to be covered without resistance, and when uncovered he seizes the meat before him contentedly. The repetition of these lessons by degrees ensures success. His wants being the chief principle of his dependence, it is endeavoured to increase his appetite by giving him little balls of flannel, which he greedily swallows. Having thus excited the appetite, care is taken to satisfy it; and thus gratitude attaches the bird to the man who but just before had been his tormentor.

When the first lessons have succeeded, and the bird shows signs of docility, he is carried out upon some green, the head is uncovered, and, by flattering him with food at different times, he is taught to jump on the fist, and to continue there. When confirmed in this habit, it is then thought time to make him acquainted with the lure. This lure is only a thing stuffed like the bird the falcon is designed to pursue, such as a heron, a pigeon, or a quail, and on this lure they always take care to give him his food. It is quite neces-

sary that the bird should not only be make acquainted with this, but fond of it, and delicate in his food when shown it. When the falcon has flown upon this, and tasted the first morsel, some falconers then take it away; but by this there is a danger of daunting the bird; and the surest method is, when he flies to seize it, to let him feed at large, and this serves as a recompense for his docility. The use of this lure is to flatter him back when he has flown in the air, which it sometimes fails to do; and it is always requisite to assist it by the voice and the signs of the master. When these lessons have been long repeated, it is then necessary to study the character of the bird; to speak frequently to him, if he be inattentive to the voice; to stint in his food such as do not come kindly or readily to the lure; to keep waking him, if he be not sufficiently familiar; and to cover him frequently with the hood, if he fears darkness. When the familiarity and the docility of the bird are sufficiently confirmed on the green, he is then carried into the open fields, but still kept fast by a string, which is about twenty yards long. He is then uncovered as before; and the falconer, calling him at some paces distance, shows him the lure. When he flies upon it, he is permitted to take a large morsel of the food which is tied to it. The next day the lure is shown him at a greater distance, till he comes at last to fly to it at the utmost length of his string. He is then to be shown the game itself alive, but disabled or tame, which he is designed to pursue. After having seized this several times with his string, he is then left entirely at liberty, and carried into the field for the purpose of pursuing that which is wild. At that he flies with avidity; and when he has seized it, or killed it, he is brought back by the voice and the lure.

By this method of instruction, a hawk may be taught to fly at any game whatsoever; but falconers have chiefly confined their pursuit only to such animals as yield them profit by the capture, or pleasure in the pursuit. The hare, the partridge, and the quail, repay the trouble of taking them; but the most delightful sport is the falcon's pursuit of the heron, the kite, or the wood-lark. Instead of flying directly forward, as some other birds do, these, when they see themselves threatened by the approach of the hawk, immediately take to the skies. They fly almost perpendicularly upward, while their ardent pursuer keeps pace with their flight, and tries to rise above them. Thus both diminish by degrees from the gazing spectator below, till they are quite lost in the clouds; but they are soon seen descending, struggling together, and using every effort on both sides; the one of rapacious insult, the other of desperate defence. The unequal combat is soon at an end; the falcon comes off victorious, and the other, killed or disabled, is made a prey either to the bird or the sportsman.

As for other birds they are not so much pursued, as they generally fly straight forward, by which the sportsman loses sight of the chase, and what is still worse, runs a chance of losing his falcon also. The pursuit of the lark, by a couple of merlins, is considered to him only who regards the sagacity of the chase, as one of the most delightful spectacles this exercise can afford. The amusement is to see one of the merlins climbing to get the ascendant of the lark, while the other lying low for the best advantage, waits the success of its companion's efforts; thus while the one stoops to strike its prey, the other seizes it at its coming down.

Such are the natural and acquired habits of these birds, which, of all others, have the greatest strength and courage relative to their size. While the kite or the goshawk approach their prey sideways, these dart perpendicularly, in their wild state, upon their game, and devour it on the spot, or carry it off, if not too large for their power of flying. They are sometimes seen descending perpendicularly from the clouds, from an amazing height, and darting down on their prey with inevitable swiftness and destruction.

The more ignoble race of birds make up by cunning and assiduity what these claim by force and celerity. Being less courageous, they are more patient; and having less swiftness, they are better skilled at taking their prey by surprise. The kite, that may be distinguished from all the rest of this tribe by his forky tail and his slow floating motion, seems almost for ever upon the wing.[1] He

[1] The kite is variously diffused throughout England, being a common bird in many parts of the country, and rare in others. In all the wooded districts of the eastern



and midland counties it is abundant: it is also met with in Westmoreland; but is seldom seen in the northern parts of Yorkshire, in Durham, or Northumberland. In Scotland, it occurs plentifully in Aberdeenshire, and is found also in the immediate vicinity of Loch Katerine,

appears to rest himself upon the bosom of the air, and not to make the smallest effort in flying. He lives only upon accidental carnage, almost every bird in the air is able to make good its retreat against him. He may be, therefore, considered as an insidious thief, who only prowls about, and when he finds a small bird wounded or a young chicken strayed too far from the mother, instantly seizes the hour of calamity, and, like a famished glutton, is sure to show no mercy. His hunger, indeed, often urges him to acts of seeming desperation. I have seen one of them fly round and round for a while to mark a clutch of chickens, and then on a sudden dart like lightning upon the unresisting little animal, and carry it off, the hen in vain crying out, and the boys hooting and casting stones to scare it from its plunder. For this reason, of all birds, the kite is the good housewife's greatest tormentor and aversion.

Of all obscene birds, the kite is the best known; but the buzzard among us is the most plenty.[1] He is a sluggish, inactive bird, and often remains perched whole days together upon the same bough. He is rather an assassin than a pursuer; and lives more upon frogs, mice, and insects, which he can easily seize, than upon birds, which he is obliged to follow. He lives in summer by robbing the nests of other birds, and sucking their eggs, and more resembles the owl kind in his countenance than any other rapacious bird of day. His figure implies the stupidity of his disposition; and so little is he capable of instruction from man, that it is common to a proverb, to call one who cannot be taught, or continues obstinately ignorant, a *buzzard*. The honey-buzzard, the moor-buzzard, and the hen-harrier, are all of this stupid tribe, and differ chiefly in their size, growing less in the order I have named them. The goshawk and sparrow-hawk are what Mr Willoughby calls short-winged birds, and consequently unfit for training, however injurious they may be to the pigeon-house or the sportsman. They have been indeed taught to fly at game; but little is to be obtained from their efforts, being

and of Ben Lomond. It is proverbial for the ease and gracefulness of its flight, which generally consists of large and sweeping circles, performed with a motionless wing, or at least with a slight and almost imperceptible stroke of its pinions, and at very distant intervals. In this manner, and directing its course by aid of the tail, which acts as a rudder, and whose slightest motion produces effect, it frequently soars to such a height as to become almost invisible to the human eye. The prey of the kite consists of young game, leverets, rats, mice, lizards, &c. which it takes by pouncing upon the ground. It is a great depredator in farm-yards after chickens, young ducks, and goslings; and is in consequence bitterly retaliated upon as a common enemy in those districts where it abounds. It will also, under the pressure of hunger, devour offal and carrion, and has been known to prey upon dead fish. It breeds early in the spring, in extensive woods, generally making its nest in the fork of a large tree. The nest is composed of sticks, lined with wool, hair, and other soft materials. The eggs are rather larger than those of a hen, and rarely exceed three in number. They are of a grayish-white, speckled with brownish-orange, principally at the larger end; but sometimes they are found quite plain.—*Abridged from Selby.*



[1] The common buzzard preys upon leverets, rabbits, game, and small birds, all of which it pounces on the ground. It also devours moles and mice, and, when pressed by hunger, will feed on reptiles and insects. It breeds in woods, and forms its nest of sticks, lined with wool, hay, and other materials, and will sometimes occupy the deserted nest of a crow. The eggs are two or three in number, larger than those of a hen, and are white, either plain or spotted with reddish-brown. The young, according to Pennant, remain in company with the parent birds for some time after having quitted the nest,—a circumstance at variance with the usual habits of birds of prey. It is common in all the wooded parts of Europe, and according to Temminck, very abundant in Holland. In France this bird is killed during the winter for the sake of its flesh, which is esteemed delicious eating.

The *Rough-legged Buzzard* is a rare British species, and can only be considered as an occasional visitant. Montagu mentions two or three instances of its having been taken in the South of England. It is a native of Norway, and other northern countries of Europe, where it frequents marshy districts, preying upon leverets, hamsters, water-rats, moles, and frequently lizards and frogs. According to Temminck, it builds in lofty trees, and lays four white eggs, spotted with reddish-brown.

The *Honey-Buzzard* preys upon moles, mice, and small birds, and on lizards and insects, particularly, wasps, bees, and their larvæ, which should appear to be their favourite food. Its flight is easy and graceful, and it is frequently seen near pieces of water, on account of the Libellulæ, and other aquatic insects. It breeds in lofty trees, forming a nest of twigs lined with wool, and other soft materials. The eggs are small, in proportion to the size of the bird, of a yellowish-white, marked with numerous spots and stains of reddish-brown, sometime so confluent as to make them appear almost entirely brown. It is a native of eastern climes, and according to Temminck, is as rare in Holland as in England. In the south of France it is more abundant, but migratory.

Allied to the Buzzards are the Harriers. They are bolder and more active than the buzzards. They strike their prey upon the ground, and generally fly very low.

The *Marsh-Harriers* abound in all the marshy districts of England and Scotland, and, according to Montagu, are very numerous in Wales, where they prey upon the rabbits that inhabit the sand-banks of the shores of

difficult of instruction, and capricious in their obedience. It has been lately asserted, however, by one whose authority is respectable, that the sparrow-hawk is the boldest and the best of all others for the pleasure of the chase.[1]

CHAP. VI.

THE BUTCHER-BIRD.

Before I conclude this short history of rapacious birds that prey by day, I must take leave to describe a tribe of smaller birds, that seem from their size rather to be classed with the harmless order of the sparrow kind; but that from their crooked beak, courage, and appetites for slaughter, certainly deserve a place here.[2] The lesser butcher-bird is not much above the size of a lark; that of the smallest species is not so big as a sparrow; yet, diminutive as these little animals are, they make themselves formidable to birds of four times their dimensions.

The greater butcher-bird is about as large as a thrush; its bill is black, an inch long and hooked at the end. This mark, together with its carnivorous appetites, ranks it among the rapacious birds; at the same time that its legs and feet, which are slender, and its toes, formed somewhat differently from the former, would seem to make it the shade between such birds as live wholly upon flesh, and such as live chiefly upon insects and grain.

Indeed, its habits seem entirely to corres-

Caermarthenshire. In Holland they are of course numerous, from the nature of the country, and rare in Switzerland.

The *Hen Harrier*, though not very numerous, is pretty generally found throughout Britain, frequenting low marshy situations, or wide moors. The flight of the hen-harrier is always low, but at the same time smooth and buoyant. It is very destructive to game, which it pounces upon the ground; it also feeds upon small birds and animals, lizards and frogs. It breeds on the open wastes, and frequently in thick furze covers; the nest is placed on the ground, and the eggs are four or five in number, of a skim-milk white, round at each end, and nearly as large as the marsh harrier's. The young males, for the first year, are similar in appearance to the females, after which they gradually assume the gray plumage that distinguishes the adult. It is common in France, Germany, and Holland, inhabiting the low and flat districts; but in Switzerland, and all mountainous countries, it is of rare occurrence. (For the American Hen Harrier, see plate XVI. fig. 10.)

The *Ash coloured Harrier*.—The British Fauna is indebted to the researches of Montagu for the discovery of this new species of falcon. The resemblance it bears to the hen harrier was without doubt the cause of its remaining so long unnoticed as a separate species, having, in all probability, when previously met with, been considered only as a variety of that bird.

The Ash-coloured harrier, is far from being numerous in England. It skims along the surface of the ground like the hen harrier, but with more rapid flight, and more strikingly buoyant. Lives upon small birds, lizards, frogs, &c. Its nest is placed upon the ground, amongst furze or low brushwood. The eggs are generally four, and of a pure white. According to Temminck, it is found throughout Hungary, in Poland, Silesia, and Austria. It is common also in Dalmatia and the Illyrian provinces, but is of rare occurrence in Italy. —*Selby*.

[1] The Secretary Falcon, (see plate XVI. fig. 3.) an inhabitant of the south of Africa, is a singular bird, for whose natural history we are chiefly indebted to the labours of M. le Vaillant. Its body, when standing erect, is not much unlike the crane; but its head, bill, and claws, are precisely those of the falcon. The general colour of the plumage is a bluish-ash. On the back of the head are several long dark-coloured feathers, hanging down behind, and which it can erect at pleasure. This crest has induced the Dutch at the Cape to give it the name of the secretary, from the resemblance they fancy it has to the pen of a writer, when in the time of leisure it is stuck behind the ear. The food to which this bird is particularly attached consists of snakes and other reptiles, for the destruction of which it is admirably fitted by its organization.

[2] The tribe of birds here noticed under the name of butcher-birds are otherwise called *shrikes*. Shrikes are spread over the entire globe, and everywhere exhibit similar dispositions, habits, and modes of existence. Of small size, but armed with a strong and crooked beak, of a fierce and courageous disposition, and of a sanguinary appetite, they bear much affinity to the birds of prey. Naturally intrepid, they defend themselves vigorously, and do not hesitate to attack birds much stronger and larger than themselves. The European shrikes can combat with advantage, pies, crows, and even kestrels. They attack and pursue these birds with great ferocity, if they dare to approach their nests. It is even sufficient if any of them should pass within reach. The male and female shrikes unite, fly forth, attack them with loud cries, and pursue them with such fury, that they often take to flight without daring to return. Even kites, buzzards, and ravens will not willingly attack the shrike. They are habitually insectivorous, and also pursue small birds. They will cast themselves on thrushes, blackbirds, &c., when these last are taken in a snare. When they have seized a bird they open the cranium, devour the brain, deplume the body, and tear it piecemeal. The prudence to foresee and provide for the wants of the future, is another of their qualities. That they may not fail of those insects which form their subsistence, and which only make their appearance at a determinate epoch, some shrikes form kinds of magazines, not in the hollows of trees, nor in the earth, but in the open air. They stick their superabundant prey on thorns, where they may find it again in the hour of need.

Falconers have taken the advantage of the character of these birds, and occasionally trained them to the chase. Francis the First of France, according to the account of Turner, was accustomed to hunt with a tame shrike, which used to speak, and return upon the hand. The Swedish hunters, availing themselves of the habit of the gray shrike of uttering a peculiar sort of cry at the approach of a hawk, make use of it to discover the birds of prey which this kind of cry announces.

Though we have said that the shrike genus is extended over the entire globe, we believe South America must be excepted. The South American birds which have been called shrikes belong to other divisions, and it would appear that this genus does not pass beyond the Floridas, Louisiana, and the north of Mexico.

pond with its conformation, as it is found to live as well upon flesh as upon insects, and thus to partake, in some measure, of a double nature. However, its appetite for flesh is the most prevalent; and it never takes up with the former when it can obtain the latter. This bird, therefore, leads a life of continual combat and opposition. As from its size it does not much terrify the smaller birds of the forest, so it very frequently meets birds willing to try its strength, and it never declines the engagement.

It is wonderful to see with what intrepidity this little creature goes to war with a pie, the crow, and the kestrel, all above four times bigger than itself, and that sometimes prey upon flesh in the same manner. It not only fights upon the defensive, but often comes to the attack, and always with advantage, particularly when the male and female unite to protect their young, and to drive away the more powerful birds of rapine. At that season, they do not wait the approach of their invader; it is sufficient that they see him preparing for the assault at a distance. It is then that they sally forth with loud cries, wound him on every side, and drive him off with such fury, that he seldom ventures to return to the charge. In these kinds of disputes, they generally come off with the victory; though it sometimes happens that they fall to the ground with the bird they have so fiercely fixed upon, and the combat ends with the destruction of the assailant as well as the defender.

For this reason, the most redoubtable birds of prey respect them; while the kite, the buzzard, and the crow, seem rather to fear than seek the engagement. Nothing in nature better displays the respect paid to the claims of courage than to see this little bird, apparently so contemptible, fly in company with the lanner, the falcon, and all the tyrants of the air, without fearing their power, or avoiding their resentment.

As for small birds, they are its usual food. It seizes them by the throat and strangles them in an instant. When it has thus killed the bird or insect, it is asserted by the best authority, that it fixes them upon some neighbouring thorn, and, when thus spitted, pulls them to pieces with its bill. It is supposed, that as Nature has not given this bird strength sufficient to tear its prey to pieces with its feet, as the hawks do, it is obliged to have recourse to this extraordinary expedient.[1]

During summer, such of them as constantly reside here, for the smaller red butcher-bird migrates, remain among the mountainous parts of the country: but in winter they descend into the plains, and nearer human habitations. The larger kind make their nests on the highest trees, while the lesser build in bushes in the fields and hedge-rows. They both lay about six eggs, of a white colour, but encircled at the bigger end with a ring of brownish red. The nest on the outside is composed of white moss, interwoven with long grass; within it is well lined with wool, and is usually fixed among the forking branches of a tree. The female feeds her young with caterpillars and other insects while very young; but soon after accustoms them to flesh, which the male procures with surprising industry. Their nature also is very different from other birds of prey in their parental care; for, so far from driving out their young from the nest to shift for themselves, they keep them with care; and even when adult they do not forsake them, but the whole brood live in one family together. Each family lives apart, and is generally composed of the male, female, and five or six young ones; these all maintain peace and subordination among each other, and hunt in concert. Upon the returning season of courtship, this union is at an end, the family parts for ever, each to establish a little household of its own. It is easy to distinguish these birds at a distance, not only from their going in companies, but also from their manner of flying, which is always up and down, seldom direct or side-ways.

Of these birds there are three or four different kinds; but the greater ash-coloured butcher-bird is the least known among us. The red-backed butcher-bird migrates in autumn, and does not return till spring. The wood-chat resembles the former, except in the colour of the back, which is brown, and not red as in the other. There is still another, less than either of the former, found in the marshes near London. This too is a bird of prey, although not much bigger than a titmouse; an evident proof that an animal's courage or rapacity does not depend upon its size. Of foreign birds of this kind there are several; but as we know little of their manner of living we will not, instead of history,

[1] The red-backed shrike or lesser butcher-bird is about seven inches long. Its bill is black; the head and lower part of the back, and coverts of the wings, are of a bright rusty red; the breast, belly, and sides, are of a fine pale rose or bloom-colour; the throat is white; a stroke of black passes from the bill through each eye; the two middle feathers of the tail are black, the others are white at the base; the quills are of a brown colour; and the legs are black. The female, like all other birds of prey, is larger than the male; it builds its nest in hedges or low bushes, and lays six white eggs, marked with a reddish-brown circle towards the larger end. This bird preys on young birds, which it takes in the nest; it likewise feeds on grasshoppers and beetles. It inhabits Great Britain, and various other temperate countries of Europe.

substitute mere description. In fact, the colours of a bird, which is all we know of them, would afford a reader but small entertainment in the enumeration. Nothing can be more easy than to fill volumes with the different shades of a bird's plumage; but these accounts are written with more pleasure than they are read; and a single glance of a good plate or a picture imprints a juster idea than a volume could convey.[1]

CHAP. VII.

OF RAPACIOUS BIRDS OF THE OWL KIND, THAT PREY BY NIGHT.

Hitherto we have been describing a tribe of animals who, though plunderers among their fellows of the air, yet wage war boldly in the face of day. We now come to a race equally cruel and rapacious; but who add to their savage disposition, the further reproach of treachery, and carry on all their depredations by night.

All birds of the owl kind may be considered as nocturnal robbers, who, unfitted for taking their prey while it is light, surprise it at those hours of rest, when the tribes of nature are in the least expectation of an enemy. Thus there seems no link in Nature's chain broken: no where a dead inactive repose: but every place, every season, every hour of the day and night, is bustling with life, and furnishing instances of industry, self-defence, and invasion.[2]

All birds of the owl kind have one common mark by which they are distinguished from others; their eyes are formed for seeing better in the dusk than in the broad glare of

[1] The great butcher-bird of America is said to stick grasshoppers upon sharp thorns for the purpose, as is supposed, of tempting the smaller birds into a situation where it can easily dart out upon them and seize them.

[2] The eye and ear of the owl are both admirably adapted to its mode of life; in the former the pupil being capable of great dilatation, and formed, by its particular prominence, for collecting the horizontal and dim rays of twilight; and being also furnished with a strong nictitating membrane, that serves, upon occasion, to defend it from the glare of day, at the same time that it allows the bird to see with sufficient distinctness for avoiding any sudden danger or surprise. The external orifices of the ears are very large and complex, generally furnished with a valve, and situated immediately behind the eyes. In consequence of this formation and disposition, they are alive to the slightest noise, and not even the rustling of a mouse can escape their notice. The flight of the owl, when disturbed during the day, is abrupt and unsteady, but, at night, it skims along in search of its prey with great facility; the delicate and downy texture of its plumage, producing the peculiar buoyancy which must have been generally remarked in the flight of these birds.

The genus is usually divided into two sections; *horned* or *eared* owls, such as have a tuft of elongated feathers on each side of the forehead, and *smooth headed* owls, or those destitute of the lengthened feathers. This second section has been subdivided by some authors into a third, called *accipitrine*; but as the gradation from one to another is almost imperceptible, and the characters upon which they have attempted to establish this subdivision are far from being distinct, it is quite sufficient for the general purposes of science to adhere to the two-fold division.

The British Fauna enumerates four species in each section, of which two in the eared owls, and three in the smooth-headed, are indigenous; the others are but occasional visitants.

Horned Owls.

Great-horned or Eagle Owl,	*Strix Bubo.*
Long-eared Owl,	*S. Otus*
Short-eared Owl,	*S. Brachyotos.*
Little-horned Owl,	*S. Scops.*

Smooth-headed Owls.

Snowy Owl,	*Strix Nyctea.*
Barn Owl,	*S. Flammea.*
Tawny Owl,	*S. Stridula.*
Little Owl,	*S. Passerina.*

Great-horned, or *Eagle Owl.*—This species, which is equal in size to some of the largest eagles, is of very rare occurrence in Great Britain; and, in the few in-



stances on record, the birds can only be regarded as wanderers, or compelled by tempest to cross the Northern ocean. It preys upon fauns, rabbits, the different species of grouse, rats, &c.—It builds amid rocks, or on lofty trees, and lays two or three eggs, larger than those of a hen, round at each end, and of a bluish-white colour. According to Temminck, it is common in Russia, Hungary, Germany, and Switzerland. It is also a native of Africa, and the northern parts of the new world.

Long-eared Owl—The excellent mixture of colours



in this bird, and the imposing appearance of its long tufts or ears, render it one of the most interesting of its genus. Though not so numerous as the barn, or the

sun-shine. As in the eyes of tigers and cats, that are formed for a life of nocturnal depredation, there is a quality in the retina that takes in the rays of light so copiously as to permit their seeing in places almost quite dark; so in these birds there is the same conformation of that organ, and though, like us, they cannot see in a total exclusion of light,

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tawny owl, it is found in most of the wooded districts of England and Scotland. Plantations of fir, particularly of the *spruce* kind, are its favourite haunts, as in these it finds a secure and sheltered retreat during the day. It also frequently inhabits thick holly or ivy bushes, whose evergreen foliage ensures a similar retirement. It is an indigenous species, and breeds early in spring; not making any nest of its own, but taking possession of that of a magpie or crow. The eggs are generally four or five in number, white, and rather larger and rounder than those of the ring-dove. When first excluded, the young birds are covered with a fine and closely set white down: they remain in the nest for more than a month before they are able to fly. If disturbed and handled, they hiss violently, strike with their talons, and, at the same time, make a snapping noise with their bills. When they quit the nest, they take up their abode in some adjoining tree, and, for many subsequent days, may be heard, after sunset, uttering a plaintive but loud call for food; during which time the parent birds may be seen diligently employed in hawking for prey. Mice and moles form the principal part of their provender; though Montagu says, that they sometimes take small birds on the roost. It is pretty generally diffused throughout Europe; and in North America is found to inhabit the woods at a distance from the sea. It has been observed as far northward as Hudson's Bay.

Short-eared Owl.—The birds of this species are only to be met with in England, between the months of October and April, as they migrate on the approach of spring, to the northern islands of Scotland, where they breed. Mr Low, in his Fauna, Orcadensis, mentions this owl as being very frequent in the hills of Hoy, where it builds its nest amongst the heath. It is there of great boldness, and has been seen to chase pigeons in the open day. In a nest, which contained two full-fledged young ones, he found the remains of a moor-fowl, and two plovers, besides the feet of several others. In this country they generally remain concealed in long grass, or in rushy places, upon waste ground, or moors. In autumn, they are often met with in turnip fields, but are seldom seen in plantations; nor do they ever attempt to perch upon a tree. Five or six of these birds are frequently found roosting together; from which circumstance it is probable that they migrate in families. Montagu thinks that this may arise from the abundance of food they meet with in the places where they are thus collected, but the truth of this supposition may be doubted, from the fact of their being seldom met with during two days together in the same place. The head of this owl being smaller than the generality of its fellow species, has procured it, in some parts, the name of *hawk owl*, or *mouse hawk*. Many ornithologists have been in doubt respecting it, and the synonymes are consequently in some confusion and obscurity. This owl is of wide locality, being met with in Siberia, and in many parts of North America; and specimens are also mentioned as having been brought from the Sandwich Islands.

The *Scops-eared Owl.*—It is very common in the warmer parts of Europe during the summer months, but regularly leaves them on the approach of autumn, for regions near to the equator. In France, it arrives and departs with the swallow. Its favourite residence in Italy, according to Spallanzani, is in the lower wooded regions.—Field and shrew mice, insects, and earth-worms, are its food, in quest of which it sallies forth at night-fall, uttering at the same time its cry, which resembles the word *chivi*, and whence, in some districts, it has acquired the name of Chevini. It constructs no nest, but deposits five or six eggs in the hollow of a tree.

Snowy Owl.—It is only within these few years past, that this noble and beautiful owl has been established as indigenous in Great Britain. In a tour made to the Orkney and Shetland Isles, in the year 1812, Mr Bullock, the late proprietor of the London Museum, met with it in both groups of islands; and it is now ascertained that the species is resident, and breeds there. It



is common in the regions of the arctic circle even inhabiting the frozen coasts of Greenland. Is very numerous on the shores of Hudson's Bay, in Norway, Sweden, and Lapland; but of very rare occurrence in the temperate parts of Europe and America.

Barn or *White Owl.*—This is the most common of the British species, and is found in every part of the kingdom. It is an inhabitant of ruins, church-towers,



barns and other buildings, where it is not liable to continual interruption; and is of essential service in checking the breed of the common and shrew mouse, upon which it subsists. On the approach of twilight it may frequently be seen issuing from its retreat to the adjoining meadows and hedge-banks in search of food, hunting with great regularity, and precipitating itself upon its prey with rapidity and unerring aim. This it swallows whole, and without any attempt to tear it in pieces with its claws. It breeds in old towers, under the eaves of churches, or in similar quiet places, and sometimes in the hollows of trees, laying from three to five eggs, of a bluish-white colour. The young, when first from the shell, are covered with white down, and are a long time in becoming fully fledged, or in being able to quit the nest. Like the other species of owls, it ejects the hair, bones, and other indigestible parts of its food, in oval pellets, by the mouth. These castings are often found in great quantities in places where these birds have long resorted. In its flight it occasionally utters loud screams.

yet they are sufficiently quick-sighted, at times when we remain in total obscurity. In the eyes of all animals, Nature hath made a complete provision, either to shut out too much light, or to admit a sufficiency, by the contraction and dilatation of the pupil. In these birds the pupil is capable of opening very wide, or shutting very close; by contracting the pupil, the brighter light of the day, which would act too powerfully upon the sensibility of the retina, is excluded; by dilating the pupil, the animal takes in the more faint rays of the night, and thereby is enabled to spy its prey, and catch it with greater facility in the dark. Besides this, there is an irradiation on the back of the eye, and the very iris itself has a faculty of reflecting the rays of light, so as to assist vision in the gloomy places where these birds are found to frequent.

But though owls are dazzled by too bright a day-light, yet they do not see best in the darkest nights, as some have been apt to imagine. It is in the dusk of the evening, or the gray of the morning, that they are best fitted for seeing, at those seasons when there is neither too much light, nor too little. It is then that they issue from their retreats, to hunt or to surprise their prey, which is usually attended with great success: it is then that they find all other birds asleep, or preparing for repose, and they have only to seize the most unguarded.

The nights when the moon shines are the times of their most successful plunder; for when it is wholly dark, they are less qualified for seeing and pursuing their prey: except, therefore, by moonlight, they contract the hours of their chase; and if they come out at the approach of dusk in the evening, they return before it is totally dark, and then rise by twilight the next morning to pursue their game, and to return in like manner, before the broad day-light begins to dazzle them with its splendour.

Yet the faculty of seeing in the night, or of being entirely dazzled by the day, is not alike in every species of these nocturnal birds: some see by night better than others; and some are so little dazzled by day-light, that they perceive their enemies, and avoid them. The common white or barn owl, for instance, sees with such exquisite acuteness in the dark, that though the barn has been shut at night, and the light thus totally excluded, yet it perceives the smallest mouse that peeps from its hole: on the contrary, the brown horned owl is often seen to prowl along the hedges by day, like the sparrow-hawk; and sometimes with good success.

All birds of the owl kind may be divided into two sorts; those that have horns, and those without. These horns are nothing more than two or three feathers that stand upon each side of the head over the ear, and give this animal a kind of horned appearance. Of the horned kind is, the Great Horned Owl, which at first view appears as large as an eagle. When he comes to be observed more closely, however, he will be found much less. His legs, body, wings, and tail, are shorter; his head much larger and thicker; his horns are composed of feathers that rise above two inches and a half high, and which he can erect or depress at pleasure: his eyes are large and transparent, encircled with an orange-coloured iris: his ears are large and deep, and it would appear that no animal was possessed with a more exquisite sense of hearing; his plumage is of a reddish brown, marked on the back with black and yellow spots, and yellow only upon the belly.

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and when perched, hisses and snores considerably. It is an abundant species throughout Europe and Asia, and Temminck says it is the same throughout North America. It is easily domesticated, and will become very tame when taken young. Montagu reared a white owl, a sparrow-hawk, and a ring-dove together, who lived in great harmony for six months. They were then set at liberty; and the owl was the only one of the three that returned.

Next to the white or barn owl, the *Tawny Owl* is the most abundant of the British species,* and is, like the former, generally dispersed throughout the kingdom; but is most readily to be met with in well-wooded districts, as it takes up its abode in woods and thick plantations, preferring those which abound in firs and holly, or ivy bushes. In such situations it remains concealed till night-fall, as it is very impatient of the glare of day, and sees, indeed, imperfectly during that time. It builds in the cavities of old trees, or will occupy the deserted nest of a crow, and produces four or five white eggs, of an elliptical shape. The young, on their exclusion, are covered with a grayish down, and are easily tamed, when fed by the hand; but Montagu observes, that if placed out of doors within hearing of their parents, they retain their native shyness, as the old birds visit them at night, and supply them with abundance of food. They prey upon rats, mice, moles, rabbits, and young leverets, and are sometimes destructive to pigeons, entering the dovecots, and committing great havock. At night this species is very clamorous, and is easily to be known from the others by its hooting, in the utterance of which sounds its throat is largely inflated.

Little Owl.—This diminutive species is only an occasional visitant in England, and that but very rarely. According to Temminck, it is never found in Europe beyond the 55th degree of north latitude; but in the warmer regions of this quarter of the globe it is very common. It inhabits ruins, church-towers, and similar old buildings, and in such it also breeds. The eggs are four or five in number, of a round shape, and white, like those of most of the other species. It is of a wild and fierce disposition, and not capable of being tamed like the little horned or scops eared owl. It sometimes preys by day, and, from having been seen to pursue swallows, must be strong and rapid on the wing. Its prey consists of mice, small birds, and insects.—*Selby's Ornithology.*

* Sir William Jardine considers the long-eared owl to be more frequently met with than the tawny owl, especially in the south of Scotland. The long eared owl is more common in America than even the barn owl.

Next to this is the Common Horned Owl, of a much smaller size than the former, and with horns much shorter. As the great owl was five feet from the tip of one wing to the other, this is but three. The horns are but about an inch long, and consist of six feathers, variegated with black and yellow.

There is still a smaller kind of the horned owl, which is not much larger than a blackbird; and whose horns are remarkably short, being composed but of one feather, and that not above half an inch high.

To these succeeds the tribe without horns. The HOWLET, which is the largest of this kind, with dusky plumes and black eyes; the SCREECH OWL, of a smaller size, with blue eyes, and plumage of an iron gray; the WHITE OWL, about as large as the former, with yellow eyes and whitish plumage; the GREAT BROWN OWL, less than the former, with brown plumage and a brown beak; and lastly, the LITTLE BROWN OWL, with yellowish coloured eyes, and an orange-coloured bill. To this catalogue might be added others of foreign denominations, which differ but little from our own, if we except the HARFANG, OR GREAT HUDSON'S BAY OWL of Edwards, which is the largest of all the nocturnal tribe, and as white as the snows of the country of which he is a native.[1]

All this tribe of animals, however they may differ in their size and plumage, agree in their general characteristics of preying by night, and having their eyes formed for nocturnal vision. Their bodies are strong and muscular; their feet and claws made for tearing their prey; and their stomachs for digesting it. It must be remarked, however, that the digestion of all birds that live upon mice, lizards, or such like food, is not very perfect; for though they swallow them whole, yet they are always seen some time after to disgorge the skin and bones, rolled up in a pellet, as being indigestible.

In proportion as each of these animals bears the daylight best, he sets forward earlier in the evening in pursuit of his prey. The great horned owl is the foremost in leaving his retreat; and ventures into the woods and thickets very soon in the evening. The horned, and the brown owl, are later in their excursions: but the barn-owl seems to see best in profound darkness, and seldom leaves his hiding-place till midnight.

As they are incapable of supporting the light of the day, or at least of then seeing and readily avoiding their danger, they keep all this time concealed in some obscure retreat, suited to their gloomy appetites, and there continue in solitude and silence. The cavern of a rock, the darkest part of a hollow tree, the battlements of a ruined and unfrequented castle, some obscure hole in a farmer's outhouse, are the places where they are usually found: if they be seen out of these retreats in the day-time, they may be considered as having lost their way; as having by some accident been thrown into the midst of their enemies and surrounded with danger.

Having spent the day in their retreat, at the approach of evening they sally forth, and skim rapidly up and down along the hedges. The barn-owl, indeed, who lives chiefly upon mice, is contented to be more stationary: he takes his residence upon some shock of corn, or the point of some old house; and there watches in the dark, with the utmost perspicacity and perseverance.

Nor are these birds by any means silent; they all have a hideous note; which, while pursuing their prey, is seldom heard; but may be considered rather as a call to courtship. There is something always terrifying in this call, which is often heard in the silence of midnight, and breaks the general pause with a horrid variation. It is different in all; but in each it is alarming and disagreeable. Father Kircher, who has set the voices of birds to music, has given all the tones of the owl note, which make a most tremendous melody. Indeed, the prejudices of mankind are united with their sensations to make the cry of the owl disagreeable. The screech-owl's voice was always considered among the people as a presage of some sad calamity that was soon to ensue.[2]

[1] For the mottled owl, see plate XVI. fig. 11; for Dalhousie's owl, see plate XV. fig. 4. Wilson has described the former of these, and other owls common to America, with his usual animation.

[2] "Up to the year 1813, the barn owl had a sad time of it at Walton Hall. Its supposed mournful notes alarmed the aged housekeeper. She knew full well what sorrow it had brought into other houses when she was a young woman; and there was enough of mischief in the midnight wintry blast, without having it increased by the dismal screams of something which people knew very little about, and which every body said was far too busy in the church-yard at night time. Nay, it was a well-known fact, that, if any person were sick in the neighbourhood, it would be for ever looking in at the window, and holding a conversation outside with somebody, they did not know whom. The gamekeeper agreed with her in everything she said on this important subject; and he always stood better in her books when he had managed to shoot a bird of this bad and mischievous family. However, in 1813, on my return from the wilds of Guiana, having suffered myself, and learned mercy, I broke in pieces the code of penal laws which the knavery of the gamekeeper and the lamentable ignorance of the other servants had hitherto put in force, far too successfully, to thin the numbers of this poor, harmless, unsuspecting tribe. On the ruin of the old gateway, against which tradition says the waves of the lake have dashed for the better part of a thousand years, I made a place with stone and mortar, about four feet square, and fixed a thick oaken stick firmly into it. Huge masses of ivy now quite cover it. In about a month or so after it was finished, a pair of barn owls came and took up their abode in it. I threatened to strangle the keeper if ever after

They seldom, however, are heard while they are preying; that important pursuit is always attended with silence, as it is by no means their intention to disturb or forewarn those little animals they wish to surprise. When their pursuit has been successful, they soon return to their solitude, or to their young, if that be the season. If, however, they find

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this he molested either the old birds or their young ones; and I assured the housekeeper that I would take upon myself the whole responsibility of all the sickness, woe, and sorrow that the new tenants might bring into the hall. She made a low courtesy; as much as to say, "Sir, I fall into your will and pleasure:" but I saw in her eye that she had made up her mind to have to do with things of fearful and portentous shape, and to hear many a midnight wailing in the surrounding woods. I do not think that up to the day of this old lady's death, which took place in her eighty-fourth year, she ever looked with pleasure or contentment on the barn owl, as it flew round the large sycamore trees which grow near the old ruined gateway.

"When I found that this first settlement on the gateway had succeeded so well, I set about forming other establishments. This year I have had four broods, and I trust that next season I can calculate on having nine. This will be a pretty increase, and it will help to supply the place of those which in this neighbourhood are still unfortunately doomed to death by the hand of cruelty or superstition. We can now always have a peep at the owls, in their habitation on the old ruined gateway, whenever we choose. Confident of protection, these pretty birds betray no fear when the stranger mounts up to their place of abode. I would here venture a surmise, that the barn owl sleeps standing. Whenever we go to look at it, we invariably see it upon the perch bolt upright, and often with its eyes closed, apparently fast asleep. Buffon and Bewick err (no doubt unintentionally) when they say that the barn owl snores during its repose. What they took for snoring was the cry of the young birds for food. I had fully satisfied myself on this score some years ago. However, in December, 1823, I was much astonished to hear this same snoring kind of noise, which had been so common in the month of July. On ascending the ruin, I found a brood of young owls in the apartment.

Upon this ruin is placed a perch, about a foot from the hole at which the owls enter. Sometimes, at mid-day, when the weather is gloomy, you may see an owl upon it, apparently enjoying the refreshing diurnal breeze. This year (1831) a pair of barn owls hatched their young on the 17th of September, in a sycamore tree near the old ruined gateway.

"If this useful bird caught its food by day, instead of hunting for it by night, mankind would have ocular demonstration of its utility in thinning the country of mice, and it would be protected and encouraged everywhere. It would be with us what the ibis was with the Egyptians. When it has young, it will bring a mouse to the nest about every twelve or fifteen minutes. But, in order to have a proper idea of the enormous quantity of mice which this bird destroys, we must examine the pellets which it ejects from its stomach in the place of its retreat. Every pellet contains from four to seven skeletons of mice. In sixteen months from the time that the apartment of the owl on the old gateway was cleaned out, there has been a deposit of a bushel of pellets.

"The barn owl sometimes carries off rats. One evening I was sitting under a shed, and killed a very large rat as it was coming out of a hole, about ten yards from where I was watching it. I did not go to take it up, hoping to get another shot. As it lay there, a barn owl pounced upon it, and flew away with it.

"This bird has been known to catch fish. Some years ago, on a fine evening in the month of July, long before it was dark, as I was standing on the middle of the bridge, and minuting the owl by my watch, as she brought mice into her nest, all on a sudden she dropped perpendicular into the water. Thinking that she had fallen down in epilepsy, my first thoughts were to go and fetch the boat; but before I had well got to the end of the bridge, I saw the owl rise out of the water with a fish in her claws, and take it to the nest. This fact is mentioned by the late much revered and lamented Mr. Atkinson of Leeds, in his compendium, in a note, under the signature of W., a friend of his, to whom I had communicated it in a few days after I had witnessed it.

"I cannot make up my mind to pay any attention to the description of the amours of the owl by a modern writer; at least the barn owl plays off no buffooneries here, such as those which he describes. An owl is an owl all the world over, whether under the influence of Momus, Venus, or Diana.

"When farmers complain that the barn owl destroys the eggs of their pigeons, they lay the saddle on the wrong horse. They ought to put it on the rat. Formerly I could get very few young pigeons till the rats were excluded effectually from the dovecot. Since that took place, it has produced a great abundance every year, though the barn owls frequent it, and are encouraged all around it. The barn owl merely resorts to it for repose and concealment. If it were really an enemy to the dovecot, we should see the pigeons in commotion as soon as it begins its evening flight; but the pigeons heed it not: whereas if the sparrow hawk or windhover should make their appearance, the whole community would be up at once, proof sufficient that the barn owl is not looked upon as a bad, or even a suspicious character, by the inhabitants of the dovecot.

"Till lately, a great and well-known distinction has always been made betwixt the screeching and the hooting of owls. The tawny owl is the only owl which hoots; and when I am in the woods after poachers, about an hour before daybreak, I hear with extreme delight its loud, clear, and sonorous notes, resounding far and near through hill and dale. Very different from these notes is the screech of the barn owl. But Sir William Jardine informs us that this owl hoots; and that he has shot it in the act of hooting. This is stiff authority: and I believe it because it comes from the pen of Sir William Jardine. Still, however, methinks that it ought to be taken in a somewhat diluted state; we know full well that most extraordinary examples of splendid talent do, from time to time, make their appearance on the world's wide stage. Thus, Franklin brought down fire from the skies:—"Eripuit fulmen cœlo, sceptrumque tyrannis." Paganini has led all London captive, by a piece of twisted catgut:—"Tu potes reges comitesque stultos ducere." Leibnitz tells us of a dog in Germany that could pronounce distinctly thirty words; Goldsmith informs us that he once heard a raven whistle the tune of the "Shamrock," with great distinctness, truth, and humour. With these splendid examples before our eyes, may we not be inclined to suppose that the barn owl which Sir William shot in the absolute act of hooting may have been a gifted bird, of superior parts and knowledge (*una de multis*, as Horace said of Miss Danaus,) endowed, perhaps, from its early days with the faculty of hooting, or else skilled in the art by having been taught it by its neighbour, the tawny owl? I beg to remark that, though I unhesitatingly grant the faculty of hooting to this one particular individual owl, still I flatly refuse to believe that hooting is common to barn owls in general. Ovid, in his sixth book *Fastorum*, pointedly says that it screeched in his days—

but little game, they continue their quest still longer ; and it sometimes happens that, obeying the dictates of appetite rather than of prudence, they pursue so long, that broad day breaks in upon them, and leaves them dazzled, bewildered, and at a distance from home.

In this distress they are obliged to take shelter in the first tree or hedge that offers, there to continue concealed all day, till the returning darkness once more supplies them with a better plan of the country. But it too often happens that, with all their precaution to conceal themselves, they are spied out by the other birds of the place, and are sure to receive no mercy. The blackbird, the thrush, the jay, the bunting, and the red-breast, all come in file, and employ their little arts of insult and abuse. The smallest, the feeblest, and the most contemptible of this unfortunate bird's enemies, are then the foremost to injure and torment him. They increase their cries and turbulence round him, flap him with their wings, and are ready to show their courage to be great, as they are sensible that their danger is but small. The unfortunate owl, not knowing where to attack or where to fly, patiently sits and suffers all their insults. Astonished and dizzy, he only replies to their mockeries by awkward and ridiculous gestures, by turning his head and rolling his eyes with an air of stupidity. It is enough that an owl appears by day to set the whole grove into a kin of uproar. Either the aversion all the small birds have to this animal, or the consciousness of their own security, makes them pursue him without ceasing, while they encourage each other by their mutual cries to lend assistance in this laudable undertaking.

It sometimes happens, however, that the little birds pursue their insults with the same imprudent zeal with which the owl himself had pursued his depredations. They hunt him the whole day until evening returns ; which restoring him his faculties of sight once more, he makes the foremost of his pursuers pay dear for their former sport. Nor is man always an unconcerned spectator here. The bird-catchers have got on an art of counterfeiting the cry of the owl exactly ; and having before limed the branches of a hedge, they sit unseen, and give the call. At this, all the little birds flock to the place where they expect to find their well-known enemy ; but instead of finding their stupid antagonist they are stuck fast to the hedge themselves. This sport must be put in practice an hour before night-fall, in order to be successful ; for if it is put off till later, those birds which but a few minutes sooner came to provoke their enemy, will then fly from him with as much terror as they just before showed insolence.

It is not unpleasant to see one stupid bird made, in some sort, a decoy to deceive another. The great horned owl is sometimes made use of for this purpose to lure the kite, when falconers desire to catch him for the purposes of training the falcon. Upon this occasion they clap the tail of a fox to the great owl, to render his figure extraordinary ; in which trim he sails slowly along, flying low, which is his usual manner. The kite, either curious to observe this odd kind of animal, or perhaps inquisitive to see whether it may not be proper for food, flies after, and comes nearer and nearer. In this manner he continues to hover, and sometimes to descend, till the falconer setting a strong-winged hawk against him, seizes him for the purpose of training his young ones at home.

The usual place where the great horned owl breeds is in the cavern of a rock, the hollow of a tree, or the turret of some ruined castle. Its nest is near three feet in diameter, and composed of sticks, bound together by the fibrous roots of trees, and lined with leaves on the inside. It lays about three eggs, which are larger than those of a hen, and of a colour somewhat resembling the bird itself. The young ones are very voracious, and the parents not less expert at satisfying the call of hunger. The lesser owl of this kind never makes a nest for itself, but always takes up with the old nest of some other bird, which it has often been forced to abandon. It lays four or five eggs ; and the young are all white at first, but change colour in about a fortnight. The other owls in general build near the place where they chiefly prey ; that which feeds upon birds, in some neighbouring grove ; that which preys chiefly upon mice, near some farmer's yard,

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" Est illis strigibus nomen : sed nominis hujus
Causa, quod horrenda stridere nocte solent."

The barn owl may be heard shrieking here perpetually on the portico, and in the large sycamore trees near the house. It shrieks equally when the moon shines, and when the night is rough and cloudy; and he who takes an interest in it may here see the barn owl the night through when there is a moon; and he may hear it shriek when perching on the trees, or when it is on wing. He may see it and hear it shriek, within a few yards of him, long before dark; and again, often after daybreak, before it takes its final departure to its wonted resting-place. I am amply repaid for the pains I have taken to protect and encourage the barn owl ; it pays me a hundredfold by the enormous quantity of mice which it destroys throughout the year. The servants now no longer wish to persecute it. Often, on a fine summer's evening, with delight I see the villagers loitering under the sycamore trees longer than they would otherwise do, to have a peep at the barn owl, as it leaves the ivy-mantled tower: fortunate for it, if, in lieu of exposing itself to danger, by mixing with the world at large, it only knew the advantage of passing its nights at home; for here

" No birds that haunt my valley free
To slaughter I condemn ;
Taught by the Power that pities me,
I learn to pity them."

where the proprietor of the place takes care to give it perfect security. In fact, whatever mischief one species of owl may do in the woods, the barn owl makes a sufficient recompense for, by being equally active in destroying mice nearer home; so that a single owl is said to be more serviceable than half a dozen cats, in ridding the barn of its domestic vermin. "In the year 1580," says an old writer, "at Hallontide, an army of mice so overrun the marshes near Southminster, that they eat up the grass to the very roots. But at length a great number of strange painted owls came and devoured all the mice." The like happened again in Essex about sixty years after.

To conclude our account of these birds, they are all very shy of man, and extremely indocile and difficult to be tamed. The white owl in particular, as Mr Buffon asserts, cannot be made to live in captivity; I suppose he means, if it be taken when old. "They live," says he, "ten or twelve days in the aviary where they are shut up; but they refuse all kind of nourishment, and at last die of hunger. By day they remain without moving upon the floor of the aviary; in the evening they mount on the highest perch, where they continue to make a noise like a man snoring with his mouth open. This seems designed as a call for their old companions without; and, in fact, I have seen several others come to the call, and perch upon the roof of the aviary, where they made the same kind of hissing, and soon after permitted themselves to be taken in a net."

A

HISTORY OF BIRDS.

BOOK III.

OF BIRDS OF THE POULTRY KIND IN GENERAL.

CHAP. I.

OF BIRDS OF THE POULTRY KIND IN GENERAL.

From the most rapacious and noxious tribe of birds, we make a transition to those which of all others are most harmless, and the most serviceable to man. He may force the rapacious tribes to assist his pleasures in the field, or induce the smaller warblers to delight him with their singing; but it is from the poultry kind that he derives the most solid advantages, as they not only make a considerable addition to the necessaries of life, but furnish out the greatest delicacies to every entertainment.

Almost, if not all, the domestic birds of the poultry kind that we maintain in our yards, are of foreign extraction; but there are others to be ranked in this class that are as yet in a state of nature; and perhaps only wait till they become sufficiently scarce to be taken under the care of man, to multiply their propagation. It will appear remarkable enough, if we consider how much the tame poultry which we have imported from distant climates has increased, and how much those wild birds of the poultry kind that have never yet been taken into keeping have been diminished and destroyed. They are all thinned; and many of the species, especially in the more cultivated and populous parts of the kingdom, are utterly unseen.

Under birds of the poultry kind I rank all those that have white flesh, and, comparatively to their head and limbs, have bulky bodies. They are furnished with short strong bills for picking up grain, which is their chief and often their only sustenance. Their wings are short and concave; for which reason they are not able to fly far. They lay a great many eggs; and, as they lead their young abroad the very day they are hatched, in quest of food, which they are shown by the mother, and which they pick up for themselves, they generally make their nests on the ground. The toes of all these are united by a membrane as far as the first articulation, and then are divided as in those of the former class.

Under this class we may therefore rank the common cock, the peacock, the turkey, the pintada or Guinea-hen, the pheasant, the bustard, the grous, the partridge, and the quail. These all bear a strong similitude to each other, being equally granivorous, fleshy, and delicate to the palate. These are among birds what beasts of pasture are among quadrupeds, peaceable tenants of the field, and shunning the thicker parts of the forest, that abound with numerous animals, who carry on unceasing hostilities against them.

As Nature has formed the rapacious class for war, so she seems equally to have fitted these for peace, rest, and society. Their wings are but short, so that they are ill formed for wandering from one region to another; their bills are also short, and incapable of annoying their opposers; their legs are strong, indeed, but their toes are made for scratching up their food, and not for holding or tearing it. These are sufficient indications of their harmless nature; while their bodies, which are fat and fleshy, render them unwieldy travellers, and incapable of straying far from each other.

Accordingly we find them chiefly in society; they live together; and though they may have their disputes, like all other animals, upon some occasions, yet when kept in the same district, or fed in the same yard, they learn the arts of subordination; and, in proportion as each knows his strength, he seldom tries a second time the combat where he has once been worsted.

In this manner, all of this kind seem to lead an indolent voluptuous life; as they are furnished internally with a very strong stomach, commonly called a gizzard, so their voraciousness scarcely knows any bounds. If kept in close captivity, and separated from all their former companions, they still have the pleasure of eating left; and they soon grow fat and unwieldy in their prison. To say this more simply, many of the wilder species of birds, when cooped or caged, pine away, grow gloomy, and some refuse all sustenance whatever; none, except those of the poultry kind, grow fat, who seem to lose all remembrance of their former liberty, satisfied with indolence and plenty.

The poultry kind may be considered as sensual epicures, solely governed by their appetites. The indulgence of these seems to influence their other habits, and destroys among them that connubial fidelity for which most other kinds are remarkable. The eagle and the falcon, how fierce soever to other animals, are yet gentle and true to each other; their connections, when once formed, continue till death; and the male and female, in every exigence, and every duty, lend faithful assistance to each other. They assist each other in the production of their young, in providing for them when produced; and even then, though they drive them forth to fight their own battles, yet the old ones still retain their former affection to each other, and seldom part far asunder.

But it is very different with this luxurious class I am now describing. Their courtship is but short and their congress fortuitous. The male takes no heed of his offspring, and satisfied with the pleasure of getting, leaves to the female all the care of providing for posterity. Wild and irregular in his appetites, he ranges from one to another; and claims every female which he is strong enough to keep from his fellows. Though timorous when opposed to birds of prey, yet he is incredibly bold among those of his own kind; and but to see a male of his own species is sufficient to produce a combat. As his desires extend to all, every creature becomes his enemy that pretends to be his rival.

The female, equally without fidelity or attachment, yields to the most powerful. She stands by a quiet meretricious spectator of their fury, ready to reward the conqueror with every compliance. She takes upon herself all the labour of hatching and bringing up her young, and chooses a place for hatching as remote as possible from the cock. Indeed she gives herself very little trouble in making her nest, as her young ones are to leave it the instant they part from the shell.

She is equally unassisted in providing for her young, that are not fed with meat put into their mouths, as in other classes of the feathered kind, but peck their food, and forsaking their nests, run here and there, following the parent wherever it is to be found. She leads them forward where they are likely to have the greatest quantity of grain, and takes care to show, by pecking, the sort proper for them to seek for. Though at other times voracious, she is then abstemious to an extreme degree; and intent only on providing for, and showing her young clutch their food, she scarcely takes any nourishment herself. Her parental pride seems to overpower every other appetite: but that decreases in proportion as her young ones are more able to provide for themselves, and then all her voracious habits return.[1]

Among the other habits peculiar to this

[1] I take great delight in observing the habits of the animals in my farm-yard. The old gander watches the sitting goose with great care, and will sometimes take his place on her nest. He is always forward to protect the goslings, and hisses at and runs after any thing from which he apprehends danger. The cock struts before the hens, and never seems so happy as when he collects them about him to feast upon a grain of corn or an insect which he has found. This gallantry is, I believe, peculiar to our domestic cock, and does him no little credit. He fights to the last extremity with any intruder, and if he is beaten, appears to consider himself unworthy of the society of his former mates, and mopes in a corner, the very picture of wretchedness.

Hen turkies are dull, and seem less capable of enjoyment than any birds I know. I have watched them stretching out their necks, and stupidly looking for a quarter of an hour together at a small tuft of grass, making short, low cries all the time. On going up to examine what occasioned this unusual movement, I have found a toad or frog concealed in the grass. Curiosity, more than fear, appeared to have attracted the turkies to the spot. They are bad mothers, and frequently trample on their young, appearing to disregard their cries. Unlike the hen, they do not take any trouble in procuring food for their young. Ducks are in a prodigious bustle when they quit their nests for food, and make a great outcry when the drake comes up to greet their arrival again in the poultry-yard. They run into the pond, flap their wings, and then come out, and are very clamorous till food is brought them. The young ducks, as soon as they are hatched, take to the water, and dart after flies with the greatest activity. I am always sorry to see the anxiety and misery of a hen who has hatched ducks, instead of her natural progeny. When they take to the water she is in a perfect agony, running round the brink of the pond, and sometimes flying into it, in hopes of rescuing her brood from the danger she apprehends them to be in. A friend of mine observed a remarkable instance of the degree to which this natural apprehension for her brood may be overcome in the hen by the habit of nursing ducks. A hen, who had reared three broods of ducks in three successive years, became habituated to their taking to the water, and would fly to a large stone in the middle of the pond, and patiently and quietly watch her brood as they swam about it. The fourth year she hatched her own eggs, and finding that her chickens did not take to the water as the ducklings had done, she flew to the stone in the pond, and called them to her with the utmost eagerness. This recollection of the habits of her former charge, though it had taken place a year before, is not a little curious.—*Jesse's Gleanings.*

class of birds is that of dusting themselves. They lie flat in some dusty place, and with their wings and feet raise and scatter the dust over their whole body. What may be their reason for thus doing, it is not easy to explain. Perhaps the heat of their bodies is such, that they require this powder to be interposed between their feathers, to keep them from lying too close together, and thus increasing that heat with which they are incommoded.

CHAP. II.

OF THE COCK.



All birds taken under the protection of man lose a part of their natural figure, and are altered, not only in their habits, but their very form. Climate, food, and captivity, are three very powerful agents in producing these alterations; and those birds that have longest felt their influence under human direction are the most likely to have the greatest variety in their figures, their plumage, and their dispositions.

Of all other birds, the cock seems to be the oldest companion of mankind, to have been first reclaimed from the forest, and taken to supply the accidental failure of the luxuries or necessities of life. As he is thus longest under the care of man, so of all others perhaps he exhibits the greatest number of varieties, there being scarce two birds of this species that exactly resemble each other in plumage and form. The tail, which makes such a beautiful figure in the generality of these birds, is yet found entirely wanting in others; and not only the tail, but the rump also. The toes, which are usually four in all animals of the poultry kind, yet in a species of the cock are found to amount to five. The feathers, which lie so sleek and in such beautiful order, in most of those we are acquainted with, are, in a peculiar breed, all inverted, and stand staring the wrong way. Nay, there is a species that comes from Japan, which instead of feathers seems to be covered all over with hair. These, and many other varieties, are to be found in this animal, which seem to be the marks this early prisoner bears of his long captivity.

It is not well ascertained when the cock was first made domestic in Europe, but it is generally agreed that we first had him in our western world from the kingdom of Persia. Aristophanes calls the cock the *Persian bird*, and tells us, he enjoyed that kingdom before some of its earliest monarchs. This animal was in fact known so early, even in the most savage parts of Europe, that we are told the cock was one of the forbidden foods among the ancient Britons. Indeed, the domestic fowl seems to have banished the wild one. Persia itself, that first introduced it to our acquaintance, seems no longer to know it in its natural form; and if we did not find it wild in some of the woods of India, as well as those of the islands in the Indian ocean, we might begin to doubt, as we do with regard to the sheep, in what form it first existed in a state of nature.[1]

But those doubts no longer exist; the cock is found in the island of Tinian, in many others of the Indian ocean, and in the woods on the coast of Malabar, in his ancient state of independence. In his wild condition, his plumage is black and yellow, and his comb and wattles yellow and purple. There is another peculiarity also in those of the Indian woods; their bones, which when boiled with us are white, as every body knows, in those

[1] The bird known in India by the name of the "Jungle Fowl" is the "Wild Cock" of Sonnerat, who was the first to describe it in his "Voyage aux Indes Orientales." This naturalist maintained with considerable zeal that this bird formed the stock whence most of our races of domestic fowl have proceeded. He concurred in the opinion of Buffon, that most of our varieties of domestic fowl have proceeded from a single type, and that the differences which we perceive among them have resulted from accidents of climate, domestication, and crossings of varieties. Sonnerat, who did not or would not know of any other species of wild cock than this—for he speaks slightingly of the authority of Dampier, who mentions that he saw wild cocks in the Indian Archipelago—naturally enough concluded that in this jungle-fowl he had found the primitive stock. Subsequent inquiries have, however, confirmed the statements of Dampier, not only as to the existence of species of wild fowl in the Indian Archipelago; but it is also admitted that the *Bankiva* species in Java, and the *Jago* species in Sumatra, more nearly approximate to our common fowl than that now under consideration, and to which Sonnerat's statements refer. Upon the whole, it seems that our varieties of domestic fowl proceed from mixtures of original species. Practical observers arrive at much the same conclusions on this point with scientific naturalists. It is thus, for instance, considered in India that our game cock originated from a mixture of the jungle cock with wild species in Malaya and Chittagong. Altogether, however, it must be admitted that, on this disputed point, very little is actually known; and the domestication of the bird ascends to such remote antiquity, that it seems hopeless to determine the era, and still more hopeless to ascertain the original species with precision.

are as black as ebony. Whether this tincture proceeds from their food, as the bones are tinctured red by feeding upon madder, I leave to the discussion of others: satisfied with the fact, let us decline speculation.

In their first propagation in Europe, there were distinctions then that now subsist no longer. The ancients esteemed those fowls whose plumage was reddish as invaluable; but as for the white, it was considered as utterly unfit for domestic purposes. These they regarded as subject to become a prey to rapacious birds; and Aristotle thinks them less fruitful than the former. Indeed his division of those birds seems to be taken from their culinary uses; the one sort he calls generous and noble, being remarkable for fecundity: the other sort, ignoble and useless, from their sterility. These distinctions differ widely from our modern notions of generosity in this animal; that which we call the *game-cock* being by no means so fruitful as the ungenerous dung-hill cock, which we treat with contempt. The Athenians had their cock matches as well as we; but it is probable that they did not enter into that refinement of choosing out the most barren of the species for the purposes of combat.

However this be, no animal in the world has greater courage than the cock, when opposed to one of his own species; and in every part of the world, where refinement and polished manners have not entirely taken place, cock-fighting is a principal diversion. In China, India, the Philippine islands, and all over the East, cock-fighting is the sport and amusement even of kings and princes. With us it is declining every day, and it is to be hoped that it will in time become only the pastime of the lowest vulgar. It is the opinion of many, that we have a bolder and more valiant breed than is to be found elsewhere; and some, indeed, have entered into a serious discussion upon the cause of so flattering a singularity. But the truth is, they have cocks in China as bold, if not bolder, than ours; and what would still be considered as valuable among cockers here, they have more strength with less weight. Indeed, I have often wondered why men who lay two or three hundred pounds upon the prowess of a single cock, have not taken every method to improve the breed. Nothing, it is probable, could do this more effectually than by crossing the *strain*, as it is called, by a foreign mixture; and whether having recourse even to the wild cock in the forests of India would not be useful, I leave to their consideration. However, it is a mean and ungenerous amusement, nor would I wish much to promote it. The truth is, I could give such instructions with regard to cock-fighting, and could so arm one of these animals against the other that it would be almost impossible for the adversary's cock to survive the first or second blow; but as Boerhaave has said upon a former occasion, when he was treating upon poisons, "to teach the arts of cruelty is equivalent to committing them."

This extraordinary courage in the cock is thought to proceed from his being the most salacious of all other birds whatsoever. A single cock suffices for ten or a dozen hens; and it is said of him, that he is the only animal whose spirits are not abated by indulgence. But then he soon grows old; the radical moisture is exhausted; and in three or four years he becomes utterly unfit for the purposes of impregnation. "Hens also," to use the words of Willoughby, "as they for the greatest part of the year daily lay eggs, cannot suffice for so many births, but for the most part, after three years, become effete and barren: for when they have exhausted all their seed-eggs, of which they had but a certain quantity from the beginning, they must necessarily cease to lay, there being no new ones generated within.

The hen seldom clutches a brood of chickens above once a season, though instances have been known in which they produced two. The number of eggs a domestic hen will lay in the year are above two hundred, provided she be well fed, and supplied with water and liberty. It matters not much whether she be trodden by the cock or no; she will continue to lay, although all the eggs of this kind can never, by hatching, be brought to produce a living animal. Her nest is made without any care, if left to herself; a hole scratched into the ground, among a few bushes, is the only preparation she makes for this season of patient expectation. Nature, almost exhausted by its own fecundity, seems to inform her of the proper time for hatching, which she herself testifies by a clucking note, and by discontinuing to lay. The good housewives, who often get more by their hens laying than by their chickens, artificially protract this clucking season, and sometimes entirely remove it. As soon as their hen begins to cluck, they stint her in her provisions; and if that fails, they plunge her into cold water: this, for the time, effectually puts back her hatching; but then it often kills the poor bird, who takes cold, and dies under the operation.[1]

[1] In the hatching of poultry, as in most other things, Nature is the best guide. The hen and duck, if left to themselves, find some dry, warm, sandy hedge or bank, in which to deposit their eggs, forming their nests of leaves, moss or dry grass. In this way the warmth is retained when the bird quits the nest for the moments she devotes to her scanty and hurried meal. The good

If left entirely to herself, the hen would seldom lay above twenty eggs in the same nest, without attempting to hatch them: but in proportion as she lays her eggs are removed; and she continues to lay, vainly hoping to increase the number. In the wild state the hen seldom lays above fifteen eggs; but then her provision is more difficultly obtained, and she is perhaps sensible of the difficulty of maintaining too numerous a family.

When the hen begins to sit, nothing can exceed her perseverance and patience; she continues for some days immovable; and when forced away by the importunities of hunger, she quickly returns. Sometimes, also, her eggs become too hot for her to bear, especially if she be furnished with too warm a nest within doors, for then she is obliged to leave them to cool a little: thus the warmth of the nest only retards incubation, and often puts the brood a day or two back in the shell. While the hen sits she carefully turns her eggs, and even removes them to different situations; till at length, in about three weeks, the young brood begin to give signs of a desire to burst their confinement. When, by the repeated efforts of their bill, which serves like a pioneer on this occasion, they have broke themselves a passage through the shell, the hen still continues to sit till all are excluded. The strongest and best chickens generally are the first candidates for liberty; the weakest come behind, and some even die in the shell. When all are produced, she then leads them forth to provide for themselves. Her affection and her pride seem then to alter her very nature, and correct her imperfections. No longer voracious or cowardly, she abstains from all food that her young can swallow, and flies boldly at every creature that she thinks is likely to do them mischief. Whatever the invading animal be, she boldly attacks him; the horse, the hog, or the mastiff. When marching at the head of her little troop, she acts the commander, and has a variety of notes to call her numerous train to their food, or to warn them of approaching danger. Upon one of these occasions I have seen the whole brood run for security into the thickest part of a hedge, when the hen herself ventured boldly forth, and faced a fox that came for plunder. With a good mastiff, however, we soon sent the invader back to his retreat; but not before he had wounded the hen in several places.

Ten or twelve chickens are the greatest number that a good hen can rear and clutch at a time; but as this bears no proportion to the number of her eggs, schemes have been imagined to clutch all the eggs of a hen, and thus turn her produce to the greatest advantage. By these contrivances it has been obtained that a hen, that ordinarily produces but twelve chickens in the year, is found to produce as many chickens as eggs, and consequently often above two hundred. The contrivance I mean is the artificial method of hatching chickens in stoves, as is practised at Grand Cairo;[1] or in a chemical elaboratory properly graduated, as has been effected by Mr Reaumur. At Grand Cairo they thus produce six or seven thousand chickens at a time; where, as they are brought forth in their mild spring, which is warmer than our summer, the young ones thrive without clutching. But it is otherwise in our colder and unequal climate; the little animal may, without much difficulty, be hatched from the shell; but they almost all perish when excluded. To remedy this, Reaumur has made use of a wollen hen, as he calls it; which was nothing more than putting the young ones in a warm basket, and clapping over them a thick-woollen canopy. I should think a much better substitute might be found; and this from among the species themselves. Capons may very easily be taught to clutch a fresh brood of chickens throughout the year; so that when one little colony is thus reared, another may be brought to succeed it. Nothing is more common than to see capons thus employed; and the manner of teaching them is this: first the capon is made very tame, so as to feed from one's hand; then, about evening, they pluck the feathers off his breast, and rub the bare skin with nettles; they then put the chickens to him, which presently run under his breast and belly, and probably rubbing his bare skin gently with their heads allay the stinging pain which the nettles had just produced. This is repeated for two or three nights, till the animal takes an affection to the chickens that have thus given him relief, and continues to give them the protection they seek for: per-

housewife's mode is the reverse of this. She makes a nest, or box, of stone, brick, or wood, and fills it with clean long straw. By these means, less heat is generated by the hen, and that which is produced quickly escapes in her occasional absences;—the eggs are chilled and addled, and frequent failures ensue in the expected brood. To obviate this, the best mode is to put at the bottom and sides of the boxes of the henhouse, a sufficient quantity of fine, dry sand, or of coal or wood ashes, lining them with a little well-broken dry grass, or untwisted haybands, or moss, or bruised straw. Wood-ashes have been found to be the best, as they produce the effect of destroying the fleas by which poultry are so much infested; and that this will not be disagreeable to them is evident from the propensity which they have to roll in heaps of dust, or of ashes of any kind. An experienced rearer of poultry adopted the method above described during a long course of years, and scarcely ever met with a disappointment.

[1] See a note on this subject in the chapter "On the Incubation of Animals," vol. i.

haps also the querulous voice of the chickens may be pleasant to him in misery, and invite him to succour the distressed. He from that time brings up a brood of chickens like a hen, clutching them, feeding them, clucking, and performing all the functions of the tenderest parent. A capon once accustomed to this service, will not give over; but when one brood is grown up he may have another nearly hatched put under him, which he will treat with the same tenderness he did the former.

The cock, from his salaciousness, is allowed to be a short-lived animal; but how long these birds live, if left to themselves, is not yet well ascertained by any historian. As they are kept only for profit, and in a few years become unfit for generation, there are few that, from mere motives of curiosity, will make this tedious experiment of maintaining a proper number till they die. Aldrovandus hints their age to be ten years; and it is probable that this may be its extent. They are subject to some disorders, which it is not our business to describe; and as for poisons, besides nux vomica, which is fatal to most animals except man, they are injured, as Linnæus asserts, by elder-berries, of which they are not a little fond.[1]

CHAP. III.

OF THE PEACOCK.



The Peacock, by the common people of Italy, is said to have the plumage of an angel, the voice of the devil, and the guts of a thief. In fact, each of these qualities mark pretty well the nature of this extraordinary bird. When it appears with its tail expanded, there is none of the feathered creation can vie

[1] The varieties of our domestic cock and hen most esteemed at present in Britain, are the following:

The common dunghill cock and hen, middle size, of every colour, and variety

The game cock and hen, rather small in size, delicate in limb, colour generally red or brown; flesh white, and superior to that of any other variety for richness and delicacy of flavour; eggs small, fine shaped, and extremely delicate: the chickens are difficult to rear from their pugnacity of disposition. The game cock has long been a bird both of cruel and curious sport in this as well as other countries; but the taste for these amusements, like that for others suited to times of comparative leisure and ignorance, is now happily on the decline in Britain.

The Dorking cock and hen, so called from the town in Surrey of that name, is the largest variety; shape handsome; body long and capacious; legs short, five claws on each foot; eggs large, and lays abundantly; colour of the flesh inclining to yellowish or ivory. Both hens and cocks often made into capons.

The Poland cock and hen were originally imported from Holland. The colour shining black, with white tops on the head of both cock and hen; head flat, surmounted by a fleshy protuberance, out of which spring the crown feathers, or top, white or black, with the fleshy king David's crown (the *celestial* in heraldry), consisting of four or five spikes; their form plump and deep; legs short, feet with five claws; lay abundantly; are less inclined to set than any other breed; they fatten quickly, and are more juicy and rich than the Dorking. On the whole, this is one of the most useful varieties. There is an ornamental subvariety known as the golden Poland, with yellow and black plumage.

The every-day cock and hen is a subvariety of the above, of Dutch origin; they are of smaller size, and said to be everlasting layers. Their tops are large, and should be periodically clipped near the eyes; otherwise, according to Mowbray, they will grow into the eyes of the fowls and render them very subject to alarm.

The bantam cock and hen is a small Indian breed, valued chiefly for its grotesque figure and delicate flesh. Mowbray mentions a subvariety, extremely small, and as smooth-legged as a game fowl. From their size and delicacy they are very convenient, as they may always be used as substitutes for chickens, when small ones are not otherwise to be had. They are also particularly useful for sitting upon the eggs of partridges and pheasants, being good nurses as well as good layers. There are two varieties of this breed, of which the more common is remarkable for having the legs and feet furnished with feathers. The other, and more scarce, variety is even smaller; and is most elegantly formed, as well as most delicately limbed. There is a society of fanciers of this breed, who rear them for prizes.

The Chittagong or Malay hen is an Indian breed, and the largest variety of the species. They are in colour striated, yellow, and dark brown; long necked, serpent-headed, and high upon the leg; their flesh dark, coarse, and chiefly adapted to soup. They are good layers; and being well fed produce large, substantial, and nutritive eggs: but these birds are too long-legged to be steady sitters.

The Shack-bag, or duke of Leeds' breed, was formerly in great repute, but is now nearly lost. It is sometimes to be met with at Wokingham (Oakingham), in Berkshire, and is so large, and the flesh so white, firm, and fine, as to afford a convenient substitute for the turkey.

The improved Spanish cock and hen is a cross between the Dorking and Spanish breed, also to be found in and around Wokingham. It is a large bird with black plumage, white and delicate flesh, the largest eggs of any British variety, and well adapted for capons.

The common variety is easily procurable; but the others must either be procured from those parts of the country where they are usually bred, or from the poulterers and bird fanciers in large towns, and especially in London. It should be a general rule to breed from young stock; a two-year-old cock, or stag, and pullets

with it for beauty; yet the horrid scream of its voice serves to abate the pleasure we find from viewing it; and still more its insatiable gluttony, and spirit of depredation, make it one of the most noxious domestics that man has taken under his protection.

Our first peacocks were brought from the East Indies; and we are assured, that they are still found in vast flocks, in a wild state, in the islands of Java and Ceylon. So beautiful a bird, and one esteemed such a delicacy at the tables of the luxurious, could not be permitted to continue long at liberty in its distant retreats. So early as the days of Solomon, we find in his navies, among the articles imported from the east, apes and peacocks. Ælian relates, that they were brought into Greece from some barbarous country, and were held in such high esteem among them, that a male and female were valued at above thirty pounds of our money. We are told also, that when Alexander was in India, he found them flying wild in vast numbers, on the banks of the river Hyarotis, and was so struck with their beauty, that he laid a severe fine and punishment on all who should kill or disturb them. Nor are we to be surprised at this, as the Greeks were so much struck with the beauty of this bird, when first brought among them, that every person paid a fixed price for seeing it; and several people came to Athens, from Lacedæmon and Thessaly, purely to satisfy their curiosity.

It was probably first introduced into the West merely on account of its beauty; but mankind, from contemplating its figure, soon came to think of serving it up for a different entertainment. Aufidius Hurco stands charged by Pliny with being the first who fatted up the peacock for the feast of the luxurious. Whatever there may be of delicacy in the flesh of a young peacock, it is certain an old one is very indifferent eating; nevertheless, there is no mention made of choosing the youngest; it is probable they were killed indiscriminately, the beauty of the feathers in some measure stimulating the appetite. Hortensius the orator, was the first who served them up at an entertainment at Rome; and from that time they were considered as one of the greatest ornaments of every feast. Whether the Roman method of cookery, which was much higher than ours, might not have rendered them more palatable than we find them at present, I cannot tell; but certain it is, they talk of the peacock as being the first of viands.

Its fame for delicacy, however, did not continue very long: for we find in the times of Francis the First, that it was a custom to serve up peacocks at the tables of the great, with an intention not to be eaten, but only to be seen. Their manner was to strip off the skin; and then preparing the body with the warmest spices, they covered it up again in its former skin; with all its plumage in full dis-

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in their second year. Pullets in their first year, if early birds, will, indeed, probably lay as many eggs as ever after; but the eggs are small, and such young hens are unsteady sitters. Hens are in their prime at three years of age, and decline after five, whence, generally, it is not advantageous to keep them beyond that period, with the exception of those of capital qualifications. Hens with a large comb, or which crow like the cock, are generally deemed inferior. Yellow-legged fowls are often of a tender constitution, and always inferior in the quality of their flesh, which is of a loose flabby texture, and ordinary flavour.

The health of fowls is observable in the fresh and florid colour of the comb, and the brightness and dryness of the eyes; the nostrils being freed from any discharge, and the healthy gloss of the plumage. The most useful cock is generally a bold, active, and savage bird, sometimes cruel, and destructive in his fits of passion, if not well watched, to his hens, and even to his offspring. Hens above the common size of their respective varieties are by no means preferable either as layers or setters. The indications of old age are paleness of the comb and gills, dullness of colour, and a sort of downy stiffness in the feathers, and length and size of talons, the scales upon the legs becoming large and prominent.

The number of hens to one cock should be from four to six, the latter being the extreme number, with a view of making the utmost advantage. Ten and even twelve hens have been formerly allowed to one cock, but the produce of eggs and chickens under such an arrangement will seldom equal that to be obtained from the smaller number of hens. Every one is aware that the spring is the best season to commence breeding with poultry, and in truth it scarcely matters how early, presupposing the best food, accommodation, and attendance, under which hens may be suffered to sit in January.

The conduct of the cock towards his hens is generally of the kindest description, and sometimes, as in the Polish breed, so remarkably so, as to be quite incredible to those who have not witnessed it. It is not an uncommon occurrence, however, for the cock to take an antipathy to some individual hen; when it continues for any length of time it is best to remove her, and supply her place by another, taking care that the stranger be not worried by the hens. Spare coops or houses will be found useful on such occasions.

The change of a cock, from death or accident, is always attended with interruption and delay, as it may be some considerable time before the hens will associate kindly with their new partner; and further, a new cock may prove dull and inactive from the change, however good in nature. This frequently happens with cocks of the superior breeds, purchased from the London dealers, in whose coops they have been kept in such a high state of temperature, that they are unable to endure the open air of the country, unless in the summer season. Such being removed in autumn, winter, or early in spring, if immediately turned abroad with hens, are liable to become aguish, torpid, and totally useless; perhaps, in the end, turning roupy or glandered. The only method of safety in this case is to keep such a cock in the house, upon the best and most nourishing food, turning the hens to him several times in the day, and permitting him to be abroad an hour or so, the weather being fine, until, in a few weeks, he shall be accustomed to the air.

play, and no way injured by the preparation. The bird thus prepared was often preserved for many years without corrupting; and it is asserted of the peacock's flesh, that it keeps longer unputrified than that of any other animal. To give a higher zest to these entertainments, on weddings particularly, they filled the bird's beak and throat with cotton and camphire, which they set on fire, to amuse and delight the company. I do not know that the peacock is much used at our entertainments at present, except now and then at an alderman's dinner, or common-council feast, when our citizens resolve to be splendid; and even then it is never served with its cotton and camphire.

Like other birds of the poultry kind the peacock feeds upon corn, but its chief predilection is for barley. But as it is a very proud and fickle bird, there is scarcely any food that it will not at times covet and pursue. Insects and tender plants are often eagerly sought at a time that it has a sufficiency of its natural food provided more nearly. In the indulgence of these capricious pursuits walls cannot easily confine it; it strips the tops of houses of their tiles or thatch, it lays waste the labours of the gardener, roots up his choicest seeds, and nips his favourite flowers in the bud. Thus its beauty but ill recompenses for the mischief it occasions; and many of the more homely looking fowls are very deservedly preferred before it.

Nor is the peacock less a debauchee in its affections, than a glutton in its appetites. He is still more salacious than even the cock; and though not possessed of the same vigour, yet burns with more immoderate desire. He requires five females at least to attend him; and if there be not a sufficient number, he will even run upon and tread the sitting hen. For this reason, the peahen endeavours as much as she can, to hide her nest from the male, as he would otherwise disturb her sitting, and break her eggs.

The peahen seldom lays above five or six eggs in this climate before she sits. Aristotle describes her as laying twelve; and it is probable in her native climate she may be thus prolific; for it is certain, that in the forests where they breed naturally, they are numerous beyond expression. This bird lives about twenty years; and not till its third year has it that beautiful variegated plumage that adorns its tail.

"In the kingdom of Cambaya," says Tavernier, "near the city of Baroch, whole flocks of them are seen in the fields. They are very shy, however, and it is impossible to come near them. They run off swifter than the partridge; and hide themselves in the thickets, where it is impossible to find them. They perch by night upon trees; and the fowler often approaches them at that season with a kind of banner, on which a peacock is painted to the life on either side. A lighted torch is fixed on the top of this decoy; and the peacock when disturbed flies to what it takes for another, and is thus caught in a noose prepared for that purpose."

There are varieties of this bird, some of which are white, others crested: that which is called the *Peacock of Thibet* is the most beautiful of the feathered creation, containing in its plumage all the most vivid colours, red, blue, yellow, and green, disposed in an almost artificial order, as if merely to please the eye of the beholder.[1]

CHAP. IV.

THE TURKEY.



The natal place of the cock and the peacock is pretty well ascertained, but there are stronger doubts concerning the turkey;[2] some contending that it has been brought into Europe from the East Indies many centuries ago; while others assert that it is wholly unknown in that part of the world, that it is a native of

[1] The *Japan Peacock* (See Plate XVIII. fig. 5.) is about the size of the crested peacock; but the bill is larger, and ash-coloured; the iris yellow, and round the eye is red. On the top of the head is an upright crest four inches long, and shaped somewhat like an ear of corn. The colour is green mixed with blue.

The *Chinese peacock* (See Plate XVIII. fig. 3.) is larger than the common peacock: the bill is black, but from the nostrils to the tip of the upper mandible red: the iris is yellow. The feathers on the crown of the head are sufficiently long to form a crest of a dull brown colour.

The *Thibet peacock* is about two feet and two inches long. The bill is above an inch and a half long, and cinereous; the iris yellow; the head, neck, and under parts are ash-coloured, marked with blackish lines; the wing-coverts, back, and rump are gray, with small white dots; besides which, on the wing-coverts and back are large round spots, of a fine blue, changing in different lights to violet and green gold.

The variety of *White Peacocks* is not very common, and these birds always bring a high price.

[2] It is now indubitably ascertained that the Turkey comes originally from America. See the following note.

the new continent, and that it was not brought into Europe till the discovery of that part of the world.

Those who contend for the latter opinion very truly observe, that among all the descriptions we have of eastern birds, that of the turkey is not to be found; while on the contrary, it is very well known in the new continent, where it runs wild about the woods. It is said by them to have been first seen in France in the reign of Francis I. and in England in that of Henry VIII. which is about the time when Mexico was first conquered by Spain. On the other hand it is asserted, that the turkey, so far from being unknown in Europe before that time, was known even to the ancients; and that Ælian has given a pretty just description of it. They allege, that its very name implies its having been brought from some part of the east; and that it is found among other dainties served up to the tables of the great, before that time among ourselves. But what they pretend to be the strongest proof is, that though the wild turkey be so numerous in America, yet the natives cannot contrive to tame it; and though hatched in the ordinary manner, nothing can render it domestic. In this diversity of opinions, perhaps it is best to suspend assent till more lights are thrown on the subject: however, I am inclined to concur with the former opinion.

With us, when young, it is one of the tenderest of all birds; yet, in its wild state, it is found in great plenty in the forests of Canada, that are covered with snow above three parts of the year. In the natural woods they are found much larger than in their state of domestic captivity. They are much more beautiful also, their feathers being of a dark gray, bordered at the edges with a bright gold colour.[1] These the savages of the country weave into cloaks to adorn their persons, and fashion into fans and umbrellas, but never once think of taking into keeping animals that the woods furnish them with in sufficient

[1] Prince Charles Lucian Bonaparte, in his American Ornithology, has give a very full and interesting account of the wild turkey. We extract it here with some abridgment.

The native country of the wild turkey extends from the north-western territory of the United States to the Isthmus of Panama, south of which it is not to be found, notwithstanding the statements of authors, who have mistaken the curassow for it. In Canada, and the now densely peopled parts of the United States, wild turkeys were formerly very abundant; but, like the Indian and buffalo, they have been compelled to yield to the destructive ingenuity of the white settlers, often wantonly exercised, and seek refuge in the remotest parts of the interior. Although they relinquish their native soil with slow and reluctant steps, yet such is the rapidity with which settlements are extended and condensed over the surface of this country, that we may anticipate a day, at no distant period, when the hunter will seek the wild turkey in vain.

The wild turkeys do not confine themselves to any particular food; they eat maize, all sorts of berries, fruits, grasses, beetles; and even tadpoles, young frogs, and lizards, are occasionally found in their crops; but where the pecan nut is plenty, they prefer that fruit to any other nourishment; their more general predilection is, however, for the acorn, on which they rapidly fatten. When an unusually profuse crop of acorns is produced in a particular section of country, great numbers of turkeys are enticed from their ordinary haunts in the surrounding districts. About the beginning of October, while the mast still remains on the trees, they assemble in flocks, and direct their course to the rich bottom lands. At this season they are observed in great numbers on the Ohio and Mississippi. The time of this irruption is known to the Indians by the name of the *turkey month*.

The males, usually termed *gobblers*, associate in parties, numbering from ten to a hundred, and seek their food apart from the females; whilst the latter either move about singly with their young, then nearly two-thirds grown, or, in company with other females and their families, form troops, sometimes consisting of seventy or eighty individuals, all of whom are intent on avoiding the old males, who, whenever opportunity offers, attack and destroy the young, by repeated blows on the skull. All parties, however, travel in the same direction, and on foot, unless they are compelled to seek their individual safety by flying from the hunter's dog, or their march is impeded by a large river. When about to cross a river, they select the highest eminences, that their flight may be the more certain: and here they sometimes remain for a day or more, as if for the purpose of consultation, or to be duly prepared for so hazardous a voyage. During this time the males *gobble* obstreperously, and strut with extraordinary importance, as if they would animate their companions, and inspire them with the utmost degree of hardihood; the females and young also assume much of the pompous air of the males, the former spreading their tails, and moving silently around. At length the assembled multitude mount to the tops of the highest trees, whence, at a signal note from a leader, the whole together wing their way towards the opposite shore. All the old and fat ones cross without difficulty, even when the river exceeds a mile in width; but the young, meagre, and weak, frequently fall short of the desired landing, and are forced to swim for their lives; this they do dexterously enough, spreading their tails for a support, closing their wings to the body, stretching the neck forwards, and striking out quickly and forcibly with their legs. If, in thus endeavouring to regain the land, they approach an elevated or inaccessible bank, their exertions are remitted, they resign themselves to the stream for a short time, in order to gain strength, and then, with one violent effort, escape from the water. But in this attempt all are not successful; some of the weaker, as they cannot rise sufficiently high in air to clear the bank, fall again and again into the water, and thus miserably perish. Immediately after the turkeys have succeeded in crossing a river, they for some time ramble about without any apparent unanimity of purpose, and a great many are destroyed by the hunters, although they are then least valuable.

When the turkeys have arrived in their land of abundance, they disperse in small flocks, composed of individuals of all sexes and ages intermingled, who devour all the mast as they advance: this occurs about the middle of November. It has been observed, that, after these long journeys, the turkeys become so familiar as to venture on the plantations, and even approach so near

abundance. Savage man seems to find a delight in precarious possession. A great part of the pleasures of the chase lies in the uncertainty of the pursuit, and he is unwilling to abridge himself in any accidental success that may attend his fatigues. The hunting the turkey, therefore, makes one of his principal diversions; as its flesh contributes chiefly

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the farmhouses as to enter the stables and corn-cribs, in search of food; in this way they pass the autumn, and part of the winter. During this season great numbers are killed by the inhabitants, who preserve them in a frozen state, in order to transport them to a distant market.

Early in March they begin to pair; and, for a short time previous, the females separate from, and shun their mates, though the latter pertinaciously follow them, uttering their gobbling note. The sexes roost apart, but at no great distance, so that, when the female utters a call, every male within hearing responds, rolling note after note, in the most rapid succession; not as when spreading the tail and strutting near the hen, but in a voice resembling that of the tame turkey, when he hears any unusual or frequently repeated noise. Where the turkeys are numerous, the woods from one end to the other, sometimes for hundreds of miles, resound with this remarkable voice of their wooing, uttered responsively from their roosting places. This is continued for about an hour; and, on the rising of the sun, they silently descend from their perches, and the males begin to strut, for the purpose of winning the admiration of their mates.

If the call be given from the ground, the males in the vicinity fly towards the individual, and, whether they perceive her or not, erect and spread their tails, throw the head backwards, distend the comb and wattles, strut pompously, and rustle their wings and body feathers, at the same moment ejecting a puff of air from the lungs. Whilst thus occupied, they occasionally halt to look out for the female, and then resume their strutting and puffing, moving with as much rapidity as the nature of their gait will admit. During this ceremonious approach, the males often encounter each other, and desperate battles ensue, when the conflict is only terminated by the flight or death of the vanquished.

This pugnacious disposition is not to be regarded as accidental, but as resulting from a wise and excellent law of nature, who always studies the good of the species, without regard to the individuals. Did not females prefer the most perfect of their species, and were not the favours of beauty most willingly dispensed to the victorious, feebleness and degeneracy would soon mark the animal creation; but, in consequence of this general rule, the various races of animals are propagated by those individuals who are not only most to be admired for external appearance, but most to be valued for their intrinsic spirit and energy.

When the object of his pursuit is discovered, if the female be more than one year old, she also struts, and even gobbles, evincing much desire; she turns proudly round the strutting male, and suddenly opening her wings, throws herself towards him, as if to terminate his procrastination, and, laying herself on the earth, receives his dilatory caresses. But should he meet a young hen, his strut becomes different, and his movements are violently rapid; sometimes rising in air, he takes a short circular flight, and on alighting drags his wings for a distance of eight or ten paces, running at full speed, occasionally approaching the timorous hen, and pressing her, until she yields to his solicitations. Thus are they mated for the season, though the male does not confine himself exclusively to one female, nor does he hesitate to bestow his attentions and endearments on several, whenever an opportunity offers.

One or more females, thus associated, follow their favourite, and roost in his immediate neighbourhood, if not on the same tree, until they begin to lay, when they change their mode of life, in order to save their eggs, which the male uniformly breaks if in his power, that the female may not be withdrawn from the gratification of his desires. At this time the females shun the males during the greater part of the day; the latter become clumsy and careless, meet each other peacefully, and so entirely cease to gobble, that the hens are obliged to court their advances, calling loudly and almost continually for them. The female may then be observed caressing the male, and imitating his peculiar gestures, in order to excite his amorousness.

The cocks, even when on the roost, sometimes strut and gobble, but more generally merely elevate the tail, and utter the *puff*, on which the tail and other feathers suddenly subside. On light or moonshining nights, near the termination of the breeding season, they repeat this action, at intervals of a few minutes, for several hours together, without rising from their perches.

The sexes then separate; the males, being much emaciated, cease entirely to gobble, retire and conceal themselves by prostrate trees, in secluded parts of the forest, or in the almost impenetrable privacy of a cane-brake. Rather than leave their hiding places, they suffer themselves to be approached within a short distance, when they seek safety in their speed of foot; at this season, however, they are of no value to the hunter, being meagre and covered with ticks. By thus retiring, using very little exercise, and feeding on peculiar grasses, they recover their flesh and strength, and when this object is attained, again congregate, and recommence their rambles.

About the middle of April, when the weather is dry, the female selects a proper place in which to deposit her eggs, secured from the encroachment of water, and, as far as possible, concealed from the watchful eye of the crow: this crafty bird espies the hen going to her nest, and having discovered the precious deposit, waits for the absence of the parent, and removes every one of the eggs from the spot, that he may devour them at leisure. The nest is placed on the ground, either on a dry ridge, in the fallen top of a dead leafy tree, under a thicket of sumach or briars, or by the side of a log: it is of a very simple structure, being composed of a few dried leaves. In this receptacle the eggs are deposited, sometimes to the number of twenty, but more usually from nine to fifteen; they are whitish, spotted with reddish brown, like those of the domestic bird.

The female always approaches her nest with great caution, varying her course so as rarely to reach it twice by the same route; and, on leaving her charge, she is very careful to cover the whole with dry leaves, with which she conceals it so artfully, as to make it extremely difficult, even for one who has watched her movements, to indicate the exact spot: hence few nests are found, and these are generally discovered by fortuitously starting the female from them, or by the appearance of broken shells, scattered around by some cunning lynx, fox, or crow. When laying or sitting, the turkey hen is not readily driven from her post by the approach of apparent danger; but, if an enemy appears, she crouches as low as possible, and suffers it to pass. A circumstance related by Mr Audubon will show how much intelligence they display on such occasions: having discovered a sitting hen, he remarked that, by assuming a careless air, whistling, or talking to himself, he was permitted to pass within five or six feet of her; but, if he advanced cautiously, she would not suffer him

to the support of his family. When he has discovered the place of their retreat, which, in general, is near fields of nettles, or where there is plenty of any kind of grain, he takes his dog with him, which is trained to the sport, (a faithful rough creature, supposed to be originally reclaimed from the wolf,) and he sends him into the midst of the flock. The

to come within twenty paces, but ran off twenty or thirty yards with her tail expanded, when, assuming a stately gait, she paused on every step, occasionally uttering a chuck. They seldom abandon their nests on account of being discovered by man, but should a snake, or any other animal, suck one of the eggs, the parent leaves them altogether. If the eggs be removed, she again seeks the male and recommences laying, though otherwise she lays but one nest of eggs during the season. Several turkey hens sometimes associate, perhaps for mutual safety, deposit their eggs in the same nest, and rear their broods together. Mr Audubon once found three females sitting on forty-two eggs. In such cases, the nest is constantly guarded by one of the parties, so that no crow, raven, nor even polecat, dares approach it.

When the process of incubation is ended, and the mother is about to retire from the nest with her young brood, she shakes herself violently, picks and adjusts the feathers about the belly, and assumes a different aspect; her eyes are alternately inclined obliquely upwards and sidewise; she stretches forth her neck, in every direction, to discover birds of prey or other enemies; her wings are partially spread, and she softly clucks to keep her tender offspring close to her side. They proceed slowly, and, as the hatching generally occurs in the afternoon, they sometimes return to pass the first night in the nest. While very young the mother leads them to elevated dry places, as if aware that humidity, during the first few days of their life, would be very dangerous to them, they having then no other protection than a delicate, soft, hairy down. In very rainy seasons wild turkeys are scarce, because, when completely wetted, the young rarely survive.

At the expiration of about two weeks, the young leave the ground on which they had previously reposed at night under the female, and follow her to some low, large branch of a tree, where they nestle under the broadly curved wings of their vigilant and fostering parent. The time then approaches in which they seek the open ground or prairie land during the day, in search of strawberries, and subsequently of dewberries, blackberries, and grasshoppers; thus securing a plentiful food, and enjoying the influence of the genial sun. They frequently dust themselves in shallow cavities of the soil, or on anthills, in order to clean off the loose skin of their growing feathers, and rid themselves of ticks and other vermin.

The young turkeys now grow rapidly, and in the month of August, when several broods flock together, and are led by their mothers to the forest, they are stout and quite able to secure themselves from the unexpected attacks of wolves, foxes, lynxes, and even cougars, by rising quickly from the ground, aided by their strong legs, and reaching with ease the upper limbs of the tallest tree. Amongst the numerous enemies of the wild turkey, the most dreaded are the large diurnal and nocturnal birds of prey, and the lynx (*Felix rufa,*) who sucks their eggs, and is extremely expert at seizing both parent and young; he follows them for some distance, in order to ascertain their course, and then, making a rapid circular movement, places himself in ambush before them, and waits until, by a single bound, he can fasten on his victim.

These birds are guardians of each other, and the first who sees a hawk or eagle gives a note of alarm, on which all within hearing lie close to the ground. As they usually roost in flocks, perched on the naked branches of trees, they are easily discovered by the large owls, and, when attacked by these prowling birds, often escape by a somewhat remarkable manœuvre. The owl sails around the spot to select his prey; but, notwithstanding the almost inaudible action of his pinions, the quick ear of one of the slumberers perceives the danger, which is immediately announced to the whole party by a *chuck;* thus alarmed, they rise on their legs, and watch the motions of the owl, who, darting like an arrow, would inevitably secure the individual at which he aimed, did not the latter suddenly drop his head, squat, and spread his tail over his back; the owl then glances over without inflicting any injury, at the very instant that the turkey suffers himself to fall headlong towards the earth, where he is secure from his dreaded enemy.

On hearing the slightest noise, wild turkeys conceal themselves in the grass, or among shrubs, and thus frequently escape the hunter, or the sharp-sighted birds of prey. The sportsman is unable to find them during the day, unless he has a dog trained for the purpose; it is necessary to shoot them at a very short distance, since, when only wounded, they quickly disappear, and, accelerating their motion by a sort of half flight, run with so much speed, that the swiftest hunter cannot overtake them. The traveller, driving rapidly down the declivity of one of the Alleghanies, may sometimes see several of them before him, that evince no urgent desire to get out of the road; but, on alighting, in hopes of shooting them, he soon finds that all pursuit is vain.

The most common mode of taking turkeys is by means of *pens*, constructed with logs, covered in at top, and with a passage in the earth under one side of it, just large enough to admit an individual when stooping. The ground chosen for this purpose is generally sloping, and the passage is cut on the lower side, widening outwards. These preparations being completed, Indian corn is strewed for some distance around the pen, to entice the flock, which, picking up the grain, is gradually led towards the passage, and thence into the enclosure, where a sufficient quantity of corn is spread to occupy the leader until the greater part of the turkeys have entered. When they raise their heads and discover that they are prisoners, all their exertions to escape are directed upwards and against the sides of the pen, not having sagacity enough to stoop sufficiently low to pass out by the way they entered, and thus they become an easy prey, not only to the experienced hunter, but even to the boys on the frontier settlements.

In proportion to the abundance or scarcity of food, and its good or bad quality, they are small or large, meagre or fat, and of an excellent or indifferent flavour: in general, however, their flesh is more delicate, more succulent, and better tasted than that of the tame turkey: they are in the best order late in the autumn, or in the beginning of winter. The Indians value this food so highly, when roasted, that they call it "the white man's dish," and present it to strangers as the best they can offer. They make much use of their tails as fans; the women weave their feathers with much art on a loose web made of the rind of the birch tree, arranging them so as to keep the down on the inside, and exhibit the brilliant surface to the eye.

Among the benefits conferred by America on the rest of the world, the gift of this noble bird should occupy a distinguished place, as unquestionably one of the most useful of the feathered tribe, being capable of ministering largely to the sustenance and comfort of the human race. Though the turkey is surpassed in external beauty by the magnificent peacock, its flesh is greatly superior

turkeys no sooner perceive their enemy, than they set off running at full speed, and with such swiftness, that they leave the dog far behind them; he follows, nevertheless, and sensible they must soon be tired, as they cannot go full speed for any length of time, he at last forces them to take shelter in a tree, where they sit quite spent and fatigued till the hunter comes up, and, with a long pole, knocks them down, one after the other.

This manner of suffering themselves to be destroyed, argues no great instinct in the animal; and, indeed, in their captive state they do not appear to be possessed of much. They seem a stupid, vain, querulous tribe, apt enough to quarrel among themselves, yet without any weapons to do each other an injury. Every body knows the strange antipathy the turkey-cock has to a red colour; how he bristles, and, with his peculiar gobbling sound, flies to attack it. But there is another method of increasing the animosity of these birds against each other, which is often practised by boys, when they have a mind for a battle. This is no more than to smear over the head of one of the turkeys with dirt, and the rest run to attack it with all the speed of impotent animosity; nay, two of them, thus disguised, will fight each other till they are almost suffocated with fatigue and anger.

But though so furious among themselves, they are weak and cowardly against other animals, though far less powerful than they. The cock often makes the turkey keep at a distance; and they seldom venture to attack him but with united force, when they rather oppress him by their weight, than annoy him by their arms. There is no animal, how contemptible soever, that will venture boldly to face the turkey-cock, that he will not fly from. On the contrary, with the insolence of a bully, he pursues any thing that seems to fear him, particularly lap-dogs and children, against both which he seems to have a peculiar aversion. On such occasions, after he has made them scamper, he returns to his female train, displays his plumage around, struts about the yard, and gobbles out a note of self-approbation.

The female seems of a milder, gentler disposition. Rather querulous than bold, she hunts about in quest of grain, and pursuit of insects, being particularly delighted with the eggs of ants and caterpillars. She lays eighteen or twenty eggs, larger than those of a hen, whitish, but marked with spots resembling the freckles of the face. Her young are

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in excellence, standing almost unrivalled for delicacy of texture and agreeable sapidity. On this account it has been eagerly sought by almost all nations, and has been naturalized with astonishing rapidity throughout the world, almost universally constituting a favourite banquet dish.

The turkey, belonging originally to the American continent, was necessarily unknown to the ancients, who, in this as in a thousand other instances, were deficient in our most common and essential articles of food. Readers unacquainted with the fact may well be surprised to learn, that, although the introduction of this bird into Europe is comparatively modern, its origin has already been lost sight of, and that eminent naturalists of the last century, who lived so much nearer to the time of its first appearance, have expressed great uncertainty concerning its native country. Thus Belon, Aldrovandi, Gessner, Ray, &c. thought that it came originally from Africa and the East Indies, and endeavoured to recognise it in some of the domestic birds of the ancients. Belon and Aldrovandi supposed it to have been mentioned by ancient authors, but they mistook for it the *Numida meleagris* of Linné, which is actually an African bird, now almost naturalized in America, even in a wild state, so that it would be apparently more reasonable for America to regard that bird as indigenous, than that the old continent should lay claim to the turkey. In so soon losing sight of the origin of this bird, we see a strong exemplification of the ungrateful disposition of man, who can durably treasure up the memory of wrongs and injuries, but fails to recollect the greatest benefits he has received. It would be loss of time to combat the arguments advanced by authors, who have deceived themselves in attempting to deprive America of her just title to this bird, since they have been fully refuted by the eloquent Buffon; but we may here introduce a sketch of its progress from America throughout Europe.

The first unquestionable description of the turkey was written by Oviedo, in 1525, in the summary of his *History of the Indies*. This bird was sent from Mexico to Spain early in the sixteenth century; from Spain it was introduced into England in 1524. Turkeys were taken to France in the reign of Francis the First, whence they spread into Germany, Italy, &c.; a few, however, had been carried to the latter country by the Spaniards, some years previously. The first turkey eaten in France appears to have been served up at the wedding banquet of Charles the Ninth, in the year 1570. Since that period they have been bred with so much care, that, in England, as we read in ancient chronicles, their rapid increase rendered them attainable at country feasts, where they were a much esteemed dish as early as 1585. Europeans conveyed them to all their colonies, and thus were they gradually introduced into Asia, Africa, and even Oceanica.

The French distinguished them by the name of *Coq et Poule d' Inde*, (cock and hen from India,) because they were natives of the West Indies. Subsequently, for the sake of brevity, they called them *Dindon*, an appellation which is yet retained. The English name is still worse, as it conveys the false idea that the turkey originated in Asia, owing to the ridiculous habit, formerly prevalent, of calling every foreign object by the name of Turk, Indian, &c.

Those who have not observed the turkey in its wild state, have only seen its deteriorated progeny, which are greatly inferior in size and beauty. So far from having gained by the care of man, and the abundance of food accessible in its state of domestication, this bird has degenerated not only in Europe and Asia, but, what is certainly extraordinary, even in its native country. The domesticated turkey of America, accustomed as it is to roam in the woods and open fields almost without restraint, is in no respect superior to that of the European poultry yard.

extremely tender at first, and must be carefully fed with curd chopped with dock-leaves; but as they grow older, they become more hardy, and follow the mother to considerable distances, in pursuit of insect food, which they prefer to any other. On these occasions, however, the female, though so large, and, as it would seem, so powerful a bird, gives them but very little protection against the attacks of any rapacious animal that comes in her way. She rather warns her young to shift for themselves, than prepares to defend them. "I have heard," says the Abbe la Pluche, "a turkey-hen, when at the head of her brood, send forth the most hideous screams, without knowing as yet the cause: however, her young, immediately when the warning was given, skulked under the bushes, the grass, or whatever else offered for shelter, or protection. They even stretched themselves at their full length upon the ground, and continued lying as motionless as if they were dead. In the meantime the mother, with her eyes directed upwards, continued her cries and screaming as before. Upon looking up to where she seemed to gaze, I discovered a black spot just under the clouds, but was unable, at first, to determine what it was; however, it soon appeared to be a bird of prey, though, at first, at too great a distance to be distinguished. I have seen one of these animals continue in this violent agitated state, and her whole brood pinned down as it were to the ground for four hours together; whilst their formidable foe has taken his circuits, has mounted, and hovered directly over their heads: at last, upon disappearing, the parent began to change her note, and sent forth another cry, which, in an instant, gave life to the whole trembling tribe, and they all flocked round her with expressions of pleasure, as if conscious of their happy escape from danger."

When once grown up, turkeys are very hardy birds, and feed themselves at very little expense to the farmer. Those of Norfolk are said to be the largest of this kingdom, weighing from twenty to thirty pounds. There are places, however, in the East Indies, where they are known only in their domestic state, in which they grow to the weight of sixty pounds.[1]

[1] A great variety of gallinaceous birds, which might easily be added to our domestic poultry, are peculiar to America. Such are especially the Curassows. In many parts of South America these birds have long been reclaimed; and it is really surprising, considering the extreme familiarity of their manners, and the facility with which they appear to pass from a state of nature to the tameness of domestic fowls, that they have not yet been introduced to the poultry-yards of Europe. That, with proper treatment, they would speedily become habituated to the climate we have no reason to doubt; on the contrary, numerous examples have shown that they thrive well even in its northern parts; and M. Temminck informs us that they have once at least been thoroughly acclimated in Holland, where they were as prolific, in their domesticated state, as any of our common poultry. The establishment, however, in which this had been effected, was broken up by the civil commotions which followed in the train of the French revolution, and all the pains which had been bestowed upon the education of these birds were lost to the world by their sudden and complete dispersion.

The plumage of the Crested Curassow (See Plate XVIII. fig. 12.) is of a deep black with a slight gloss of green upon the head, crest, neck, back, wings and upper part of the tail; and dull white beneath and on the lower tail-coverts. Its crest is from two to three inches in length, and occupies the whole upper surface of the head: it is curled and velvety in its appearance, and capable of being raised or depressed at will, in accordance with the temporary feelings by which the bird is actuated. The eyes are surrounded by a naked skin, which extends into the cere and there assumes a bright yellow colour. In size the bird is almost equal to a turkey. This species is a native of Mexico, Guiana, and Brasil, and probably extends itself over a large portion of the southern division of the American continent. In the woods of Guiana it appears to be so extremely common that M. Sonnini regards it as the most certain resource of a hungry traveller, whose stock of provisions is exhausted, and who has consequently to trust to his gun for furnishing him with a fresh supply. They congregate together in numerous flocks, and appear to be under little or no uneasiness from the intrusion of men into their haunts. Even when a considerable number of them have been shot, the rest remain quietly perched upon the trees, apparently unconscious of the havoc that has been committed among them. This conduct is by no means the result of stupidity, but proceeds rather from the natural tameness and unsuspiciousness of their character. Those, however, which frequent the neighbourhood of inhabited places are said to be much wilder and more mistrustful, being kept constantly on the alert to avoid the pursuit of the hunters, who destroy them in great numbers. They build their nests on the trees, forming them externally of branches interlaced with the stalks of herbaceous plants, and lining them internally with leaves. They generally lay but once a-year, during the rainy season; the number of their eggs being, according to Sonnini, five or six, and to D'Azara as many as eight.

CHAP. V.

THE PHEASANT.



It would surprise a sportsman to be told, that the pheasant which he finds wild in the

woods, in the remotest parts of the kingdom, and in forests which can scarcely be said to have an owner, is a foreign bird, and was at first artificially propagated amongst us. They were brought into Europe from the banks of the Phasis, a river of Colchis, in Asia Minor; and from whence they still retain their name.

Next to the peacock, they are the most beautiful of birds, as well for the vivid colour of their plumes, as for their happy mixtures and variety. It is far beyond the power of the pencil to draw any thing so glossy, so bright, or points so finely blended into each other. We are told that when Crœsus, king of Lydia, was seated on his throne, adorned with royal magnificence, and all the barbarous pomp of eastern splendour, he asked Solon if he had ever beheld any thing so fine? The Greek philosopher, no way moved by the objects before him, or taking a pride in his native simplicity, replied, that after having seen the beautiful plumage of the pheasant, he could be astonished at no other finery.

In fact, nothing can satisfy the eye with a greater variety and richness of ornament than this beautiful creature. The iris of the eye is yellow; and the eyes themselves are surrounded with a scarlet colour, sprinkled with small specks of black. On the forepart of the head there are blackish feathers mixed with a shining purple. The top of the head and the upper part of the neck are tinged with a darkish green, that shines like silk. In some, the top of the head is of a shining blue, and the head itself, as well as the upper part of the neck, appears sometimes blue and sometimes green, as it is differently placed to the eye of the spectator. The feathers of the breast, the shoulders, the middle of the back, and the sides under the wings, have a blackish ground, with edges tinged of an exquisite colour, which appears sometimes black and sometimes purple, according to the different lights it is placed in; under the purple there is a transverse streak of gold colour. The tail, from the middle feathers to the root, is about eighteen inches long; the legs, the feet, and the toes, are of the colour of horn. There are black spurs on the legs, shorter than those of a cock; there is a membrane that connects two of the toes together; and the male is much more beautiful than the female.

This bird, though so beautiful to the eye, is not less delicate when served up to the table. Its flesh is considered as the greatest

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They are nearly as large as those of a turkey, but are white like a hen's, and with a thicker shell.

The *Galeated Curassow* (see Plate XVIII. fig. 1.) is in size about equal to the crested curassow. Its head and neck are covered with short black velvety feathers; and all the rest of the plumage, with the exception of the white abdomen, and under tail-coverts, is of a brilliant black, exhibiting, in certain positions, a slight tinge of green. The tail-feathers are tipped with white. The legs are red; the claws yellow; the iris brown. The bill is of a bright red; and the protuberance by which it is surmounted (which is rounded in the young birds, and pear-shaped with the narrow end directed forwards in adult males), is of a livid slate-colour. This remarkable projection is more than two inches in length when fully developed; it is hard and bony externally, and internally cellular, the cells communicating with the cavity of the mouth. It is not visible until after the first moulting, when it begins to make its appearance in the form of a small tubercle, and attains a much larger size in the male than in the female. In other respects there is little difference between the sexes; and the young are only distinguished by a browner tinge. The windpipe descends for a considerable distance in front of the sternum, immediately beneath the skin, and makes no less than three distinct convolutions before passing into the cavity of the chest. These birds are natives of Mexico, and live in large bands, perching upon the trees, but more commonly building their nests upon the ground.

The *Razor-billed Curassow's* most distinctive character consists in the form of the horny process that surmounts its bill, which rises above the level of the head, is flattened on the sides, runs anteriorly into a sharp edge, spreads out at the base where it is continuous with the bill, and is, like it, of a bright red. The whole of the upper parts, the fore part of the neck, the breast, and the legs, are black, with a violet or purple gloss. The tail is of the same colour for the greater part of its length, but terminates in a white band; and the extreme part of the belly is of a chestnut brown. Above the base of the bill, which is covered with short velvety feathers concealing the nostrils, is a tuft of straight feathers; the iris is dusky, and the naked legs are reddish brown. In the young bird the horny process of the bill is smaller, and less intensely red. It has not yet been attempted to naturalize the present species in this quarter of the globe; but its flesh, according to Marcgrave, in whatever mode prepared, but especially when roasted, yields to that of no bird either of Europe or America. He adds that it is domesticated and cultivated by the gentry of Brazil, on account both of its dignity and elegance.

The *Guan* is of the same family with the curassows, and closely allied to those birds both in structure and general appearance. It is nevertheless distinguished by several remarkable peculiarities. The bill is much shallower, its transverse diameter exceeding its depth, somewhat elongated, and naked at the base; the nostrils are placed about the middle of the bill, and are not at all concealed by the advancement of the feathers of the head; a naked space surrounds the eyes; the skin of the throat is destitute of feathers and capable of considerable distension; the claws are strong, curved, and pointed; and the hinder toe is articulated on the same level with the anterior ones, and consequently applies its whole length to the surface of the ground. As in the other genera of the family, the bill is convex above and curved at the point; the legs are of moderate length and without spurs; the wings short, with the sixth quill-feather longest; and the tail flat, rounded at the extremity, and formed of twelve broad feathers. From its long domestication in the poultry yards of South America, it is subject to very extensive variations. It is the largest bird of the genus that has yet been discovered, measuring when fully grown about thirty inches in total length, of which the tail constitutes thirteen or fourteen. The whole upper surface of the body is of a dusky black or bronze colour with a gloss of green, which becomes olive in certain positions with regard to light. —*Supplement to the English edition of Cuvier.*

dainty; and when the old physicians spoke of the wholesomeness of any viands, they made their comparison with the flesh of the pheasant. However, notwithstanding all these perfections to tempt the curiosity or the palate, the pheasant has multiplied in its wild state; and, as if disdaining the protection of man, has left him, to take shelter in the thickest woods and the remotest forests. All others of the domestic kind, the cock, the turkey, or the pintado, when once reclaimed, have still continued in their domestic state, and persevered in the habits and appetites of willing slavery. But the pheasant, though taken from its native warm retreats, where the woods supply variety of food, and the warm sun suits its tender constitution, has still continued its attachment to native freedom; and now wild among us, makes the most envied ornament of our parks and forests, where he feeds upon acorns and berries, and the scanty produce of our chilling climate.

This spirit of independence seems to attend the pheasant even in captivity. In the woods, the hen pheasant lays from eighteen to twenty eggs in a season; but in a domestic state she seldom lays above ten. In the same manner when wild she hatches and leads up her brood with patience, vigilance, and courage; but when kept tame, she never sits well; so that a hen is generally her substitute upon such such occasions; and as for leading her young to their food, she is utterly ignorant of where it is to be found: and the young birds starve, if left solely to her protection. The pheasant therefore, on every account, seems better left at large in the woods, than reclaimed to pristine captivity. Its fecundity when wild is sufficient to stock the forest; its beautiful plumage adorns it; and its flesh retains a higher flavour from its unlimited freedom.[1]

However, it has been the aim of late to take these birds once more from the woods, and to keep them in places fitted for their reception. Like all others of the poultry

[1] The pheasants (*phasianidæ*) form one of the most interesting groups of the feathered race, whatever be the point of view in which we contemplate them. Their beauty of form and the splendour of their hues, have attracted universal admiration. Many dazzle by the metallic lustre of their plumage, which gleams with green, and blue, and gold. Such, for example, is the case with that gorgeous bird the Impeyan pheasant (*Lophophorus Impeyanus*) of the Himalayan mountains, which it has several times been attempted to bring alive into this country, but hitherto without success. Others, as the golden pheasant of China (*phasianus*



pictus), delight us with the richness and multiplicity of their tints, which contrast admirably with each other. The common pheasant, now naturalized over the greater portion of Europe, is exceedingly beautiful, but it is far surpassed by many of its congeners, of which we may mention that elegant Chinese species the *Phasianus Reevesii* (*P. venesatus*, Temm.), of which a fine specimen adorns the Gardens of the Zoological Society. It is to be observed, however, that this beauty of plumage is confined to the males; the females are universally attired in a sober dress of brown, often indeed exquisitely pencilled with spots and zigzag lines, but totally destitute of the brilliant hues which glisten in their mates. Independently, however, of the beauty of the pheasant tribe, there is another point of interest which cannot be overlooked—we allude to their value as it respects the table. The flesh of all the gallinaceous birds affords to man a wholesome and nutritious food, and that of the pheasants is deservedly in high estimation. Hence the introduction and naturalization of the common pheasant in western Europe is a positive good, and it is desirable therefore to add other species to the list of those which are acclimated with us.

The pheasants (family *Phasianidæ*) are all natives of Asia. The common pheasant was originally brought from the river Phasis by the Greeks in some of their earlier expeditions; that of the Argonauts under Jason has the popular credit of having introduced it. However this may be, the name given to the bird by the Greeks (φασιανος, in Latin *Phasianus*) of which all our modern European names for it are merely corruptions, points to the banks of the Phasis as the place from which it was derived; and to the present day the pheasants of Mingrelia (the Colchis of the ancients) are celebrated for their beauty and size. Extreme brilliancy of plumage is in general the characteristic of birds dwelling in torrid regions beneath a glowing sky; such is not the case as it regards the most gorgeous and beautiful of the pheasant tribe. On the contrary, the high mountains of the Himalaya, bordering upon the limits of perpetual snow, are tenanted by the most splendid of this family. The Impeyan pheasant is an example in point: adapted for regions where the temperature is at the most only moderate, and often at a low degree, this noble bird soon dies when taken from its alpine home into the burning lowlands of India; and hence arises one of the difficulties in the way of our obtaining living specimens in Europe. But besides the Impeyan pheasant, the Himalaya chain of mountains presents us with a group or genus of this family, containing a very limited number of species remarkable both for their great beauty and their characters, which indicate an affinity to the turkeys, between which group and that of the genuine pheasants, they constitute an intermediate link. The genus to which we allude is that termed *Tragopan*, (Cuvier,) of which three species only are known. They are easily distinguishable from all the rest of the *Phasianidæ* (at least as far as regards the male birds) by the presence of large throat-wattles, or naked caruncled flaps of skin, (resembling those of the turkey), which extend from the naked cheeks, spread over the throat, and proceed down each side of the neck, while from behind each eye rises a soft fleshy horn. The whole of these appendages are capable of being contracted and dilated at pleasure, or at least in accordance with the emotions of anger, fear, &c., as we see in the male turkey: the tints of the horns and wattles are rich purple, mingled with scarlet, and are most probably changeable from one hue to another. The tail is broad and rounded, and the plumage is dotted with

kind, they have no great sagacity, and suffer themselves easily to be taken. At night they roost upon the highest trees of the wood; and by day they come down into the lower brakes and bushes, where their food is chiefly found. They generally make a kind of flapping noise when they are with the females; and this often apprises the sportsman of their retreats. At other times he tracts them in the snow, and frequently takes them in springs. But of all birds they are shot most easily, as they always make a whirring noise when they rise, by which they alarm the gunner, and being a large mark, and flying very slow, there is scarcely any missing them.

Ah! what avail his glossy, varying dyes,
His purpled crest, and scarlet circled eyes,
The vivid green his shining plumes unfold,
His painted wings, and breast that flames with gold.
POPE.

When these birds are taken young into keeping, they become as familiar as chickens; and when they are designed for breeding, they are put together in a yard, five hens to a cock; for this bird, like all of the poultry kind, is very salacious. In her natural state the female makes her nest of dry grass and leaves; the same must be laid for her in the pheasantry, and she herself will sometimes

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round spots of white on a brown or red ground, the effect of which is very pleasing.

Of the three species that are known at present, two have been but recently introduced to science, nor, indeed, is our acquaintance with the one first described of distant date. The first species is the horned pheasant of Nepal (*Tragopan satyrus*), (see Plate XVIII. fig. 24.; for Argus Pheasant, see fig. 8.; and Diard's Pheasant, fig. 10.) It was first described and figured by Edwards, in the third volume of his "Natural History of Birds," p. 116,—partly from a drawing sent from India to Dr Mead, and partly from a head of the bird preserved in spirits which accompanied the drawing. Edwards's third volume is dated 1750, and his plate was etched in 1749, as appears by the date inscribed in the corner. The alliance of this bird to the turkey was not unobserved by this writer, who in his catalogue places it among that group, while in his account of it he observes that it is, "for shape of body and proportion of parts, pretty much like a turkey, and may be ranged with fowls of the poultry kind." Dr Latham, in his "General History of Birds," states that these birds, though by no means common, "are not unfrequent in drawings done in India; and are particularly well figured in those of Mr Middleton and Lady Impey." * * * "In the drawings of Sir J. Anstruther it is said to inhabit the snowy regions of Thibet." Its size is between that of a fowl and turkey. It is beautifully figured in Gould's "Century of Birds."

The second species is from Thibet and the Chinese borders, and was first described and figured in the "Indian Zoology," by Mr Gray, under the title of *Tragopan Temminckii*. Of this species, as rare as it is beautiful, a living specimen, presented by J. R. Reeves, Esq., is now in the Gardens of the Zoological Society, and constitutes, as far as we are aware, the first example of one of the present group having reached our shores alive and in health. It was procured in China.

The third species is from the northern range of the Himalaya, and was first illustrated in Mr Gould's "Century," under the name of *Tragopan Hastingsii*; the figures are those of an adult and young male, and adult female. In size this species rather exceeds the *Tragopan satyrus*, its total length being twenty-three inches. The head of the adult male is covered with a pendent crest of feathers, which, together with the ear-coverts and the throat, are black; the neck and shoulders are rich maroon; the chest, fine orange red; the naked skin round the eyes is scarlet; the wattles and horns, purple, tinted here and there with scarlet. The upper parts exhibit a mixture of zigzag lines, and marks of dark and light brown, forming a ground on which are scattered numerous distinct spots of white. The feathers of the under surface are maroon, bordered with black, and having each a large central spot of white. The young male is less brilliant, and the wattles are but little developed.

The plumage of the female consists of an uniform brown, mottled, barred, and dashed irregularly with dark brown and dull fawn colour; the cheeks are clothed with feathers, and the head is slightly crested: there are neither horns nor pendent wattles.

Of the habits and manners of these noble birds in a state of nature little is accurately known. The strength of their legs (*tarsi*), which are clothed with large scales, and in the males armed with a short sharp spur, together with the rounded form of the wings, indicate them to be chiefly terrestrial. The bill is strong and large, but wants that spoonlike form of the tip of the upper mandible, so conspicuous in the Impeyan pheasant (*Lophophorus Impeyanus*), by which it is adapted for the scooping up of bulbous roots, on which that bird is known to feed. Most probably the diet of the present group consists, as in others of the *rasorial order*, of grains, roots, and the larvæ of ants and various insects.

Could the horned pheasants, or the refulgent Impeyan pheasant, be imported in sufficient numbers into our island (and we trust this will be soon accomplished), there is little doubt but that they might, with proper management, become naturalized. There is nothing to fear with regard to cold. They are the natives of a cold or temperate region;—they verge upon the line of perpetual snow;—so that the wooded hills of our portion of the globe would not be very uncongenial to their constitution. Nor would there be much difficulty in providing them with suitable food. Grain forms the staple diet of all the gallinaceous tribe;—hence the peacock of India, the guinea-fowl of Africa, the common pheasant of Asia, the turkey of America, have equally become naturalized and have multiplied in our western regions—to say nothing of the common fowl, the origin of which is from India, but which, from time immemorial, has been reclaimed or domesticated, and has long since spread in this condition over the greatest portion of the globe. Thus the food of the gallinaceous tribe, and the hardiness of their constitution, fit most of them, at least, for a very extensive diffusion throughout the globe; and in this we may discern a wise arrangement of nature, inasmuch, as of all the feathered race, they are the most valuable to man, and are at once ornaments around his dwelling and wholesome delicacies on his table. If to our poultry-yard could be added the horned pheasants, so closely allied to them in form, habits, and general manners, they would constitute a most important acquisition, and produce a full reward for the trouble bestowed in their naturalization.—*Penny Magazine.*

properly dispose them. If she refuses to hatch her eggs, then a common hen must be got to supply her place, which task she will perform with perseverance and success. The young ones are very difficult to be reared; and they must be supplied with ants' eggs, which is the food the old one leads them to gather when wild in the woods. To make these go the farther, they are chopped up with curds, or other meat; and the young ones are to be fed with great exactness, both as to the quantity and the time of their supply. This food is sometimes also to be varied, and woodlice, earwigs, and other insects, are to make a variety. The place where they are reared must be kept extremely clean; their water must be changed twice or thrice a day; they must not be exposed till the dew is off the ground in the morning; and they should always be taken in before sunset. When they become adult, they very well can shift for themselves, but they are particularly fond of oats and barley.

In order to increase the breed, and make it still more valuable, Longolius teaches us a method that appears very peculiar. The pheasant is a very bold bird, when first brought into the yard among other poultry, not sparing the peacock, nor even such young cocks and hens as it can master; but after a time it will live tamely among them, and will at last be brought to couple with a common hen. The breed thus produced take much stronger after the pheasant than the hen; and in a few successions, if they be left to breed with a cock pheasant, (for the mixture is not barren,) there will be produced a species more tame, stronger, and more prolific; so that he adds, that it is strange why most of our pheasantries are not stocked with birds produced in this manner.

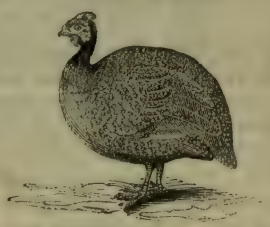
The pheasant, when full grown, seems to feed indifferently upon every thing that offers. It is said by a French writer, that one of the king's sportsmen shooting at a parcel of crows, that were gathered round a dead carcase, to his great surprise, upon coming up, found that he had killed as many pheasants as crows.[1] It is even asserted by some, that such is the carnivorous disposition of this bird, that when several of them are put together in the same yard, if one of them happens to fall sick, or seems to be pining, that all the rest will fall upon, kill, and devour it. Such is the language of books; those who have frequent opportunities of examining the manners of the bird itself, know what credit ought to be given to such an account.

[1] When pheasants are observed pecking at carrion, it is not the carrion they are eating, but the maggots upon it, of which they are fond.

Of the pheasant, as of all other domestic fowl, there are many varieties. There are white pheasants, crested pheasants, spotted pheasants; but of all others, the golden pheasant of China is the most beautiful. It is a doubt whether the peacock itself can bear the comparison. However, the natives of China would not have us consider it as their most beautiful bird, though covered all over with eyes, resembling in miniature those of the peacock. By their accounts, it is far exceeded by the fongwang, an imaginary bird, of which they give a most fantastic description. It is thus that the people of every country, though possessed of the greatest advantages, have still others that they would persuade strangers they enjoy, which have existence only in the imagination.

CHAP. VI.

THE PINTADO, OR GUINEA-HEN.



This is a very remarkable bird, and in some measure unites the characteristics of the pheasant and the turkey. It has the fine delicate shape of the one, and the bare head of the other. To be more particular, it is about the size of a common hen, but as it is supported on longer legs, it looks much larger. It has a round back, with a tail turned downwards like a partridge. The head is covered with a kind of casque; and the whole plumage is black or dark gray, speckled with white spots. It has wattles under the bill, which do not proceed from the lower chap as in cocks, but from the upper, which gives it a very peculiar air; while its restless gait and odd chuckling sound distinguish it sufficiently from all other birds whatever.

It is well known all over Europe, and even better than with us, as the nations that border on the Mediterranean probably had it before us from those parts of Africa which lay near est. Accordingly we find it in different countries called by different names, from the place whence they had it. They are by some called the *Barbary-hen;* by others, the *Tamis bird;* and by others, the *bird of Numidia.*[1] We

[1] The pintado is the bird formerly known to the an

have given it the name of that part of Africa from whence, probably, it was first brought.

In many parts of their native country, they are seen in vast flocks together, feeding their young, and leading them in quest of food. All their habits are like those of the poultry kind, and they agree in every other respect, except that the male and female are so much alike, that they can hardly be distinguished asunder. The only difference lies in the wattles described above; which in the cock are of a bluish cast; in the hen they are more inclining to a red. Their eggs, like their bodies, are speckled; in our climate, they lay but five or six in a season; but they are far more prolific in their sultry regions at home. They are kept among us rather for show than use, as their flesh is not much esteemed, and as they give a good deal of trouble in rearing.

CHAP. VII.

THE BUSTARD.

The Bustard is the largest land bird that is a native of Britain. It was once much more numerous than at present; but the increased cultivation of the country, and the extreme delicacy of its flesh, has greatly thinned the species; so that a time may come when it may be doubted whether ever so large a bird was bred among us. It is probable that long before this the bustard would have been extirpated, but for its peculiar manner of feeding. Had it continued to seek shelter among our woods, in proportion as they were cut down, it must have been destroyed. If in the forest, the fowler might approach it without being seen; and the bird, from its size, would be too great a mark to be easily missed. But it inhabits only the open and extensive plain, where its food lies in abundance, and where every invader may be seen at a distance.

The bustard is much larger than the turkey, the male generally weighing from twenty-five to twenty-seven pounds. The neck is a foot long, and the legs a foot and a half. The wings are not proportionable to the rest of the body, being but four feet from the tip of the one to the other; for which reason the bird flies with great difficulty. The head and neck of the male are ash-coloured; the back is barred transversely with black, bright, and rust colour. The greater quill-feathers are black; the belly white; and the tail, which consists of twenty feathers, is marked with broad black bars.

It would seem odd, as was hinted before, how so large a land bird as this could find shelter in so cultivated a country as England; but the wonder will cease when we find it only in the most open countries, where there is scarce any approaching it without being discovered. They are frequently seen in flocks of fifty or more, in the extensive downs of Salisbury Plain, in the heaths of Sussex and Cambridgeshire, the Dorsetshire uplands, and so on as far as East Lothian in Scotland[1] In those extensive plains, where there are no woods to screen the sportsman, nor hedges to creep along, the bustards enjoy an indolent security. Their food is composed of the berries that grow among the heath, and the large earth-worms that appear in great quantities on the downs before sun-rising in summer. It is in vain that the fowler creeps forward to approach them, they have always sentinels placed at proper eminences, which are ever on the watch, and warn the flock of the smallest appearance of danger. All therefore that is left the sportsman, is the comfortless view of their distant security. He may wish; but they are in safety.

It sometimes happens that these birds, though they are seldom shot by the gun, are often run down by the greyhounds. As they are voracious and greedy, they often sacrifice their safety to their appetite, and feed themselves so very fat, that they are unable to fly without great preparation. When the greyhound, therefore, comes within a certain distance, the bustard runs off flapping its wings, and endeavouring to gather air enough under them to rise; in the meantime, the enemy approaches nearer and nearer, till it is too late for the bird even to think of obtaining safety by flight; for just at the rise there is always time lost, and of this the bird is sensible; it continues, therefore, on the foot, until it has got a sufficient way before the dog for flight, or until it is taken.

As there are few places where they can at once find proper food and security, so they generally continue near their old haunts, seldom wandering above twenty or thirty miles from home. As their food is replete with moisture, it enables them to live upon these dry plains, where there are scarcely any springs of water, a long time without drinking. Besides this, Nature has given the males an admirable magazine for their security against thirst. This is a pouch, the entrance of which lies immediately under the

cients under the name of Meleagris or Numidian Fowl. Its flesh was much esteemed by the Romans. Among the varieties of this bird are the *Crested* Pintado (See Plate XVIII. fig. 11.) and the *Mitred* Pintado.

[1] The Great Bustard is now extremely scarce in Britain. Indeed, Selby is inclined to believe that the breed in this country is extinct.

tongue, and capable of holding near seven quarts of water.[1] This is probably filled upon proper occasions, to supply the hen when sitting, or the young before they can fly.

Like all other birds of the poultry kind, they change their mates at the season of incubation, which is about the latter end of summer. They separate in pairs, if there be a sufficiency of females for the males: but when this happens to be otherwise, the males fight until one of them falls. In France, they often find some of those victims to gallantry dead in the fields, and no doubt are not displeased at the occasion.

They make their nests upon the ground, only just scraping a hole in the earth, and sometimes lining it with a little long grass or straw. There they lay two eggs only, almost of the size of a goose egg, of a pale olive brown, marked with spots of a darker colour. They hatch in about five weeks, and the young ones run about as soon as they are out of the shell.

The bustards assemble in flocks in the month of October, and keep together till April. In winter, as their food becomes more scarce, they support themselves indiscriminately, by feeding on moles, mice, and even little birds, when they can seize them. For want of other food, they are contented to live upon turnip-leaves, and such like succulent vegetables. In some parts of Switzerland, they are found frozen in the fields in severe weather; but when taken to a warm place, they again recover. They usually live fifteen years, and are incapable of being propagated in a domestic state, as they probably want that food which best agrees with their appetite.

[1] The reservoir is capable of holding only about half the above quantity.

The female bustard is not much more than half the size of the male. The top of her head is of a deep orange, and the rest of the head brown. Her colours are not so bright as those of the male, and she wants the tuft on each side of the head. She also wants the reservoir.

There are eleven species of this bird; viz. the Arabian Passurrage, Ruffed, Indian, White-eared, White-chinned, Thick-kneed, Chilese, Great and Little Bustard. The two latter are natives of our island.

The *Little Bustard* (See Plate XVIII. fig. 34.)—Length seventeen inches. The female is smaller, and has not the black collar on the neck; in other respects she nearly resembles the male. This bird is very uncommon in this country but is common in France, where it is taken in nets, like the partridge. It is a very shy and cunning bird; if disturbed, it flies two or three hundred paces, not far from the ground, and then runs away much faster than one can follow on foot. The female lays her eggs in June, to the number of three or four, of a glossy green colour: as soon as the young are hatched, she leads them about, as the hen does her chickens. They begin to fly about the middle of August. Both this and the great bustard are excellent eating, and, we should imagine, would well repay the trouble of domestication; indeed, it seems surprising that we should suffer these fine birds to run wild, and be in danger of total extinction, which, if properly cultivated, might afford as excellent a repast as our own domestic poultry, or even as the turkey, for which we are indebted to distant countries.

CHAP. VIII.

THE GROUSE, AND ITS AFFINITIES.[2]

The cock of the wood, the black cock, the grouse, and the ptarmigan—these are all birds

[2] The high latitudes of North America produce numerous species of grouse, most of which are peculiar to that continent; two or three of these are also found in the parallel latitudes of Europe: while, on the other hand, there are in Europe several species peculiar to our portion of the globe, and of these one at least is very limited in the extent of its habitat. Thus the *lagopus saliceti*, or willow-grouse, (see Plate XVIII. fig. 17.) which inhabits the fur-countries from the fiftieth to the seventieth parallels of latitude, is also abundant in Scandinavia, Kamtschatka, Greenland and Iceland. The *tetrao rupestris*, or rock-grouse, which abounds in Melville Island and the Barren Grounds, is common in Sweden and Norway; while on the contrary the black grouse (*tetrao tetrix*) is peculiar to Europe, as is also the capercailzie (*tetrao urogallus*); and the red grouse (*lagopus Scoticus*) is even more circumscribed, being exclusively a native of the British islands.

We shall proceed to offer a few observations respectively on the two groups into which the tribe of European grouse naturally divide themselves: these we may characterize as *forest-grouse*, comprehended in the genus *tetrao*, and as *moorland* or *ptarmigan grouse*, comprehended in the genus *lagopus*. It is in the genus *tetrao* that the largest of the tribe are found; but this genus is by no means so numerous in species as that of *lagopus*. The pine and birch forests which clothe the mountains and hills of the colder latitudes are their abode; they seldom visit the open country, but prefer the densest recesses of the wood, where they perch with ease upon the branches. Shy, recluse, and wary, they retire from the presence of the intruder, and seek refuge in the deep wooded glens which intervene between the mountains, where vast morasses teem with a luxuriant growth of willow, alder, birch, and trees of a similar nature. Hence it requires much address and caution to approach within range of gun-shot. Their food consists of the tender shoots of pines, the seeds of plants, the berries of various species of *vaccinium* and *arbutus*, the buds of the birch and alder, leaves and grain. In their habits they are polygamous. As the breeding season draws on, the male birds choose each for themselves a certain territory, from which the possessor drives every intruding rival. Desperate combats are then continually taking place, the weaker or less fortunate being obliged to quit the precincts of the station; and it not unfrequently happens that the contest terminates only with the death of the defeated. Secure in his temporary dominion, the proud victor raises a call of invitation morning and evening, which resounds through the wood, and brings his bevy of mates to the selected spot. The nest is very simply constructed, consisting of dried grasses, and placed upon the ground, sheltered among the herbage.

The genus *tetrao* is characterized, among other points,

of a similar nature, and chiefly found in heathy mountains and piny forests, at a distance from mankind. They might once indeed have been common enough all over England, when a great part of the country was covered with heath; but at present their numbers are thinned; the two first of this kind are utterly unknown in the south, and have taken refuge in the northern parts of Scotland, where the extensive heaths afford them security, and the forest shelter.

The cock of the wood is sometimes of the size of a turkey, and often weighs near fourteen pounds; the black cock, of which the male is all over black, though the female is of the colour of a partridge, is about the size of a hen, and, like the former, is only found with us in the highlands of Scotland;[1] the grouse is about half as large again as a partridge, and its colour much like that of a wood-cock, but redder; the ptarmigan is still somewhat less, and is of a pale brown or ash colour.

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by a peculiarity in the structure of the toes, which deserves especial attention. The tarsi are covered with hairlike feathers, but the toes are bare, having their edges strongly pectinated, or fringed with an array of rough prominences; for this remarkable fact it is difficult to assign a reason perfectly satisfactory to inquirers; our own opinion is, that it is a provision for enabling the birds to grasp securely the smooth branches of the trees on which they perch, but more especially when they are covered with frozen snow, or a coat of glassy ice, which in the forests of the north is a common winter occurrence.

In their flight the forest grouse are rapid for short distances, but the motion of their wings is accompanied by a whirring noise, like that of the pheasant. The scarlet-fringed skin above the eye, so peculiar an ornament in the grouse-tribe, they possess in great perfection: the beak is stout, short, and convex; the nostrils are hidden beneath a tuft of close small feathers, enveloping the base of the upper mandible.

Two species of this genus are indigenous in the British islands;—one is the black grouse, common in the pine woods of Scotland, and of the northern counties of England, and elsewhere;—the other, we regret to say, is no longer a sojourner among us,—it is the capercailzie or cock of the wood.—*See the following note.*

[1] The cock of the woods, which was once plentiful in Scotland, where it was called the *capercailzie*, is now no longer to be found there. This bird is by far the most



magnificent of the tribe to which it belongs, and must have been a truly worthy tenant of those splendid primeval forests which once overspread our country. The male is nearly three feet in length, and attains a weight of about fifteen pounds; black, brown, green, and white, are his predominating colours; and from the hook of his bill, the strength of his limbs, and majesty of deportment, he might rather be supposed to be a bird of prey than even the chief of the grouse family of gallinæ. The numbers of the capercailzie naturally decreased in Scotland with the woods that gave them shelter, and it is now about sixty years since the last native individual of the species ever seen in the country was shot in the neighbourhood of Inverness. They are now most plentiful in the forests of Northern Europe, and some parts of Northern Asia, where they feed on the young shoots and cones of the pine, the catkins of the birch, and berries of the juniper which form the underwood. They are exceedingly shy, and in Germany, where they do not abound so much as in Norway and Sweden, he is considered an excellent hunter who has in a whole lifetime killed thirty. It is indeed only at the period of incubation, when the male bird comes from his retirement, and calls the females around him, that he is easily approachable. Nevertheless, in Sweden they are sometimes domesticated in aviaries, and feed tamely from the hand, and will even breed in confinement, though it is remarked that in this state they still retain so much of their natural wildness as to fly at and peck strangers.

Nilsson, a Norwegian naturalist, used to hunt the capercailzie in autumn, in company with a cocker dog called Brunette, by whose assistance he would flush them from the ground, and cause them to perch in the trees. "Here," he says, "as Brunette had the eye of an eagle and the foot of an antelope, she was not long in following them. Sometimes, however, those birds were in the pines in the first instance; but as my dog was possessed of an extraordinarily fine sense of smelling, she would often wind, or, in other words, scent them from a long distance. When she found the capercailzie, she would station herself under the tree where they were sitting, and, by keeping up an incessant barking, direct my steps towards the spot. I now advanced with silence and caution; and as it frequently happened that the attention of the bird was much taken up with observing the dog, I was enabled to approach until it was within the range of my rifle, or even of my common gun. In the forest, the capercailzie does not always present an easy mark; for, dipping down from the pines nearly to the ground, as is frequently the case, they are often almost out of distance before one can properly take aim."

Towards the commencement and during the continuance of winter, the capercailzies are generally in packs; these, which are usually of cocks (the hens keeping apart), do not separate until the approach of spring. These packs, which are sometimes said to contain fifty or a hundred birds, usually hold to the sides of the numerous lakes and morasses with which the northern forests abound; and to stalk the same in the wintertime, with a good rifle, is no ignoble amusement.

Among other expedients resorted to in the northern forests for the destruction of the capercailzie, is the following:—During the autumnal months, after flushing and dispersing the brood, people place themselves, in ambush, and imitate the cry of the old or young birds, as circumstances may require. By thus attracting them to the spot, they are often enabled to shoot the whole brood in succession. The manner in which this is practised may be better understood from what Mr Grieff says on the subject:—

"After the brood has been dispersed, and you see the growth they have acquired, the dogs are to be bound up, and a hut formed precisely on the spot where the birds were driven from, in which you place yourself to call; and you adapt your call according to the greater or less size of your young birds. When they are as large as

They are all distinguishable from other birds of the poultry kind by a naked skin of a scarlet colour, above the eyes, in the place and of the figure of eye-brows.

the hen, you ought not to begin to call until an hour after they have been flushed; should you wish to take them alive, the common net is placed round him who calls. Towards the quarter the hen flies, there are seldom to be found any of the young birds, for she tries by her cackling to draw the dogs after her, and from her young ones. As long as you wish to shoot, you must not go out of your hut to collect the birds you have shot. When the hen answers the call, or lows like a cow, she has either got a young one with her, or the calling is incorrect; or else she has been frightened, and will not then quit her place. A young hen answers more readily to the call than an old one."

Mr Lloyd, in his amusing work, the *Field Sports of the North of Europe*, describes a still more remarkable mode of hunting the capercailzie—namely, by torchlight—which he says is chiefly practised in the southern provinces of Sweden. "In Smaland and Ostergothland," says he, "it is effected in the following manner:—Towards nightfall, people watch the last flight of the capercailzie before they go to roost. The direction they have taken into the forest is then carefully marked, by means of a prostrate tree, or by one which is felled especially for the purpose. After dark, two men start in pursuit of the birds; one of them is provided with a gun, the other with a long pole, to either end of which a flambeau is attached. The man with the flambeau now goes in advance, the other remaining at the prostrate tree, to keep it and the two lights in an exact line with each other; by this curious contrivance they cannot well go astray in the forest. Thus they proceed, occasionally halting, and taking a fresh mark, until they come near to the spot where they may have reason to suppose the birds are roosting. They now carefully examine the trees; and when they discover the objects of their pursuit, which are said stupidly to remain gazing at the fire blazing beneath, they shoot them at their leisure. Should there be several capercailzies in the same tree, however, it is always necessary to shoot those in the lower branches on the first instance; for unless one of these birds falls on its companions, it is said the rest will never move, and, in consequence, the whole of them may be readily killed."

An attempt is now in the course of being made to restore to the pine forests of Aberdeenshire a bird which once formed the object of a stately sport among our national nobility, and adorned the grandest of their feasts. In the year 1828, a male and female were imported for this purpose from Sweden by the earl of Fife, but as the hen died before landing, the experiment was on that occasion frustrated. Another pair was brought over in 1829, and placed in a proper aviary at Mar Lodge, where an incubation took place, but without producing a live bird. Another incubation of the same hen in 1830 was equally unsuccessful, and it was not till 1831, and till particular pains had been taken for the preservation and proper hatching of the eggs, by the seclusion of the female, that a brood was obtained. According to the latest intelligence from the scene of this experiment, it is designed, as soon as a few healthy broods have been reared in confinement, to liberate a few in the old pine woods of Braemar, and thus eventually to stock with the finest of feathered game the noblest of Scottish forests.

Inferior though it be to the capercailzie, there still remains in Scotland a very fine species of grouse—the *black-grouse* or *black-cock*. This bird, though not larger than the common hen, weighs nearly four pounds; its length is about one foot ten inches, breadth two feet nine.

It seems to be something extraordinary, that all the larger wild animals of every species choose the darkest and the inmost recesses of the woods for their residence, while the

The bill is black; the eyes dark blue; below each eye



there is a spot of a dark white colour, and above, a large one, of a bright scarlet, which extends almost to the top of the head; the general colour of the plumage is a deep black, richly glossed with blue on the neck and rump; the lesser wing-coverts are dusky brown; the greater are white, which extends to the ridge of the wing, forming a spot of that colour on the shoulder, when the wing is closed: the quills are brown, the lower parts and tips of the secondaries are white, forming a bar of white across the wing: there is likewise a spot of white on the bastard wing; the feathers of the tail are almost square at the ends, and, when spread out, form a curve on each side; the under tail coverts are of a pure white; the legs and thighs are of a dark brown colour, mottled with white; the toes are toothed on the edges, like those of the former species. In some of our specimens the nostrils are thickly covered with feathers, whilst in others they are quite bare, probably owing to the different ages of the birds. These birds, like the former, are found chiefly in high and woody situations in the northern parts of our island; they are common in Russia, Siberia, and other northern countries: they feed on various kinds of berries and other fruits, the produce of wild and mountainous places. In summer they frequently come down from their lofty situations, for the sake of feeding upon corn. They do not pair; but, on the return of spring, the males assemble in great numbers, at their accustomed resorts, on the tops of high and heathy mountains, when the contest for superiority commences, and continues with great bitterness till the vanquished are put to flight. The victors, being left in possession of the field, place themselves on an eminence, clap their wings, and with loud cries give notice to their females, who immediately resort to the spot. It is said, that each cock has two or three hens, which seem particularly attached to him. The female is about one-third less than the male, and differs from him considerably in colour; her tail is likewise much less forked. She makes an artless nest on the ground, where she lays six or eight eggs of a yellowish colour, with freckles and spots of a rusty brown. The young cocks at first resemble the mother, and do not acquire their male garb till towards the end of autumn, when the plumage gradually changes to a deeper colour, and assumes that of a bluish black, which it afterwards retains.

The Red Grouse, or *Muirfowl*.—The weight of the male is about nineteen, and of the female fifteen ounces. The bill is black; and at the base of the lower mandible there is on each side a white spot. Each eye is arched with a large, naked, scarlet spot. The throat is red. The plumage of the upper part of the body is mottled with dusky red and black. The breast and belly are purplish, crossed with small dusky lines. The heathy and mountainous parts of the northern counties of England are in general well stocked with red grouse.

smaller kinds come more into the open and cultivated parts, where there is more food and more danger. It is thus with the birds I am describing: while the cock of the wood is seldom seen, except on the inaccessible parts of heathy mountains, or in the midst of piny forests, the grouse is found in great numbers in the neighbourhood of corn-fields, where

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These birds are likewise very common in Wales, and the highlands of Scotland; but they have not yet been observed in any of the countries of the continent. In winter they are usually found in flocks of sometimes forty or fifty in number, which are termed, by sportsmen, *packs*, and become remarkably shy and wild. They keep near the summits of the heathy hills, seldom descending to the lower grounds; here they feed on the mountain-berries, and on the tender tops of the heath. They pair in spring; and the females lay from six to ten eggs, in a rude nest formed on the ground. The young brood (which during the first year are called *poults*) follow the hen till the approach of winter, when they unite with several others into packs. Red grouse have been known to breed in confinement, in the menagerie of the late Duchess Dowager of Portland. This was, in some measure, effected by her grace causing fresh pots of heath to be placed in the menagerie almost every day. The flesh, as in all others of this tribe, is an excellent food; but it soon corrupts. To prevent this, the bird should be drawn immediately after they are shot.

White Grouse, or *Ptarmigan*.—This bird is nearly the same size as the red grouse. Its bill is black; the



upper parts of its body are of a pale brown or ash-colour, mottled with small dusky spots and bars: the bars on the head and neck are somewhat broader, and are mixed with white; the under parts are white, as are also the wings, excepting the shafts of the quills, which are black. This is its summer dress, which in winter is changed to a pure white, excepting that in the male there is a black line between the bill and the eye. The tail consists of sixteen feathers; the two middle ones are ash-coloured in summer, and white in winter; the next two are slightly marked with white near the ends; the rest are wholly black: the upper tail coverts are long, and almost cover the tail. The white grouse is fond of lofty situations, where it braves the severest cold. It is found in most of the northern parts of Europe, even as far as Greenland; in this country it is only to be met with on the summits of some of our highest hills, chiefly in the highlands of Scotland, in the Hebrides and Orkneys, and sometimes, but rarely, on the lofty hills of Cumberland and Wales. Buffon, speaking of this bird, says, that it avoids the solar heat, and prefers the biting frost on the tops of mountains; for as the snow melts on the sides of mountains, it constantly ascends, till it gains the summit, where it forms holes and burrows in the snow. They pair at the same time as the red grouse. The female lays eight or ten eggs, which are white, spotted with brown: she makes no nest, but deposits them on the ground. In winter they fly in flocks; and are so little accustomed to the sight of man, that they are easily shot, or taken in a snare. They feed on the wild productions of the hills, which sometimes gives the flesh a bitter, but not unpalatable taste; it is dark-coloured, and, according to M. Buffon, has somewhat the flavour of the hare.

The Rock Grouse.—Orange, with black bands and white blotches; the toes are downy; the tail feathers black, tipt with white; the middle ones are entirely white. The rock grouse inhabits Hudson's Bay; is less than the last; it does not frequent woods, but sits on the tops of rocks, and makes a cry like a man calling with a loud voice.

The Sand Grouse.—Its collar, belly, and vent are black; the tail feathers are barred with brown and gray, and tipt with white; the two middle ones are tawnyish: the head is ashy; the chin, pale yellow, with a black semi-circle on the throat, the feathers truncate and shining; the tail is barred, the two middle feathers subulate at the tip; the legs behind are naked, having a small spur. The female of this species is yellowish, having the head and neck spotted with black, and the back is barred with black. For banded sand grouse, see Plate XVIII. fig. 19; for Pallas's sand grouse, see fig. 27; for spotted grouse, see fig. 18.

The Heteroclitous Grouse.—The feet are three-toed; the toes are downy, and connected nearly to the tips. The heteroclitous grouse inhabits the southern deserts of Tartary; it is an ambiguous bird, between the bustard and the grouse. The bill is more slender than in others of the tribe; the upper mandible neither arched, nor receiving the lower one. Its head and neck are hoary; the chin tawnyish, with an orange spot on each side of the neck; the back is waved with gray and black; the breast is of a pale reddish ash-colour; the belly, flanks, and vent are black; the wings long and pointed, white beneath, and dotted with black above.

Among the other varieties of grouse, are the *Ruffed Grouse*—the *Pinnated Grouse*—the *Hazel Grouse*, pretty generally spread throughout the central countries of Europe—the *Pintado Grouse*, a native of the cold regions of North America—and the *Willow Grouse*, which inhabits the north of Europe and America, as far as the ices of the pole.

The *Cock of the plain*. This splendid bird is the



largest of the American grouse; and, as far as beauty, size, and rarity are concerned, bears the same rank in the American fauna with the wood-grouse, or cock of the wood of Europe. He is equally sought after by the huntsman, and is even now as difficult to procure as that we have just compared him to. But the form and habits are quite distinct. In our once native bird the form is remarkably powerful, the tail rounded and very ample, the habitation, the most extensive forests, delighting to perch on the highest trees. The bird of America inhabits only the uncovered plains, never perches, and the form of the tail is lengthened, the feathers narrowing to a point. This acquisition to the grouse was first noticed in the expedition of Lewis and Clark, who met with it near the fountain of the Missouri, in the heart of the Rocky mountains, and also on the Columbia river. A figure was first given of it by Bonaparte, from a specimen in the possession of Mr Leadbetter. Both sexes were again figured in Mr Wilson's Illustrations of Zoo-

there is heath to afford retreat and shelter.—Their food too somewhat differs; while the smaller kind lives upon heath blossoms, cranberries, and corn, the larger feeds upon the cones of the pine-tree; and will sometimes entirely strip one tree before it offers to touch those of another, though just beside him. In other respects, the manners of these birds are the same; being both equally simple in their diet, and licentious in their amours.

The cock of the wood, for it is from him we will take our description, is, as was said, chiefly fond of a mountainous and woody situation. In winter he resides in the darkest and inmost parts of the woods; in summer, he ventures down from his retreats, to make short depredations on the farmer's corn. The delicacy of his flesh, in some measure, sets a high price upon his head; and as he is greatly sought after, so he continues, when he comes down from the hills, always on his guard. Upon these occasions, he is seldom surprised; and those who would take him, must venture up to find him in his native retreats.

The cock of the wood, when in the forests, attaches himself principally to the oak and the pine-tree; the cones of the latter serving for his food, and the thick boughs for a habitation. He even makes a choice of what cones he shall feed upon; for he sometimes will strip one tree bare before he will deign to touch the cones of another. He feeds also upon ants' eggs, which seem a high delicacy to all birds of the poultry kind: cranberries are likewise often found in his crop; and his gizzard, like that of domestic fowls, contains a quantity of gravel, for the purpose of assisting his powers of digestion.

At the earliest return of spring, this bird begins to feel the genial influence of the season. During the month of March, the approaches of courtship are continued, and do not desist till the trees have all their leaves and the forest is in full bloom. During this whole season, the cock of the wood is seen at sunrise and setting, extremely active, upon one of the largest branches of the pine-tree. With his tail raised and expanded like a fan, and the wings drooping, he is seen walking backward and forward, his neck stretched out, his head swollen and red, and making a thousand ridiculous postures: his cry upon that occasion is a kind of loud explosion, which is instantly followed by a noise like the whetting of a scythe, which ceases and commences alternately for about an hour, and is then terminated by the same explosion.

During the time this singular cry continues, the bird seems entirely deaf and insensible of every danger; whatever noise may be made near him, or even though fired at, he still continues his call; and this is the time that sportsmen generally take to shoot him. Upon all other occasions, he is the most timorous and watchful bird in nature; but now he seems entirely absorbed by his instincts; and seldom leaves the place where he first begins to feel the accesses of desire. This extraor-

logy, and an excellent representation of the male is given in the Northern Zoology.

The total length of the male is thirty-one and a half inches, that of the female twenty-two. The colour of the plumage is a beautiful mixture of yellowish-brown, mottled and varied with deeper tints, the under parts nearly white, with longitudinal streaks of brown, and the centre of the belly dotted with large black patches. On each side of the breast are two round naked protuberances, placed farther forward than those of *T. cupido*, or pinnated grouse. Above each there is a tuft of feathers, having their shafts considerably elongated, naked, and tipped with black radii. On the sides of the neck and across the breast, below the protuberances, the feathers are short, rigid, and sharp-pointed, but lie over each other with the same regularity as the scales of a fish. The tail is eleven inches long, each feather lanceolate, and is gradually attenuated to a fine point. The female has the whole of the upper plumage umber-brown and yellowish-white, barred or mottled in equal proportions. Under part nearly as in the male, but without the projecting stiff feathers.

The description of the manners of this species by Mr Douglass, is the best account we yet have. "The flight of these birds is slow, unsteady, and affords but little amusement to the sportsman. From the disproportionately small, convex, thin-quilled wing,—so thin, that a vacant space half as broad as a quill appears between each,—the flight may be said to be a sort of fluttering, more than any thing else: the bird giving two or three claps of the wings in quick succession, at the same time hurriedly rising; then shooting or floating, swinging from side to side, gradually falling, and thus producing a clapping, whirring sound. When started the voice is *cuck, cuck, cuck*, like the common pheasant. They pair in March and April. Small eminences on the banks of streams are the places usually selected for celebrating the weddings, the time generally about sunrise. The wings of the male are lowered, buzzing on the ground, the tail spread like a fan, somewhat erect, the bare yellow œsophagus inflated to a prodigious size, fully half as large as his body, and, from its soft membranous substance, being well contrasted with the scale-like feathers below it on the breast, and the flexile silky feathers on the neck, which on these occasions stand erect. In this grotesque form he displays, in the presence of his intended mate, a variety of attitudes. His love-song is a confused grating, but not offensively disagreeable tone—something that we can imitate, but have a difficulty of expressing—'*Hur-hur-hur-r-r-r-hoo*,' ending in a deep hollow tone, not unlike the sound produced by blowing into a large reed. Nest on the ground under the shade of *Purshia* and *Artemisia*, or near streams, among *Phalaris arundinacea*, carefully constructed of dry grass and slender twigs. Eggs from thirteen to seventeen, about the size of a common fowl, of a wood-brown colour, with irregular chocolate blotches on the thick end. Period of incubation from twenty-one to twenty-two days. The young leave the nest a few hours after they are hatched." "In summer and autumn months these birds are seen in small troops, and in winter and spring in flocks of several hundreds. Plentiful throughout the barren, arid plains of the river Columbia: also in the interior of North California. They do not exist on the banks of the river Missouri; nor have they been seen in any place east of the Rocky Mountains."

dinary cry, which is accompanied by a clapping of the wings, is no sooner finished, than the female, hearing it, replies, approaches, and places herself under the tree, from whence the cock descends to impregnate her. The number of females that, on this occasion, resort to his call is uncertain; but one male generally suffices for all.

The female is much less than her mate, and entirely unlike him in plumage, so that she might be mistaken for a bird of another species: she seldom lays more than six or seven eggs, which are white, and marked with yellow, of the size of a common hen's egg; she generally lays them in a dry place, and a mossy ground, and hatches them without the company of the cock. When she is obliged, during the time of incubation, to leave her eggs in quest of food, she covers them up so artfully, with moss or dry leaves, that it is extremely difficult to discover them. On this occasion, she is extremely tame and tranquil, however wild and timorous in ordinary. She often keeps to her nest, though strangers attempt to drag her away.

As soon as the young ones are hatched, they are seen running with extreme agility after the mother, though sometimes they are not entirely disengaged from the shell. The hen leads them forward, for the first time, into the woods, shows them ants' eggs, and the wild mountain-berries, which, while young, are their only food. As they grow older, their appetites grow stronger, and they then feed upon the tops of heather, and the cones of the pine-tree. In this manner they soon come to perfection; they are a hardy bird, their food lies everywhere before them, and it would seem that they should increase in great abundance. But this is not the case; their numbers are thinned by rapacious birds and beasts of every kind; and still more by their own salacious contests.

As soon as the clutching is over, which the female performs in the manner of a hen, the whole follow the mother for about a month or two, at the end of which the young males entirely forsake her, and keep in great harmony together till the beginning of spring. At this season, they begin, for the first time, to feel the genial access; and then adieu to all their former friendship! They begin to consider each other as rivals; and the rage of concupiscence quite extinguishes the spirit of society. They fight each other like game-cocks; and at that time are so inattentive to their own safety, that it often happens that two or three of them are killed at a shot. It is probable that in these contests, the bird which comes off victorious takes possession of the female seraglio, as it is certain they have no faithful attachments.

CHAP. IX.

OF THE PARTRIDGE, AND ITS VARIETIES.

The Partridge may be particularly considered as belonging to the sportsman. It is a bird which even our laws have taken under protection; and, like a peacock or a hen, may be ranked as private property. The only difference now is, that we feed one in our farms, the other in our yards; that these are contented captives; those, servants that have it in their power to change their master, by changing their habitation.[1]

"These birds," says Willoughby, "hold the principal place in the feasts and entertainments of princes; without which their feasts are esteemed ignoble, vulgar, and of no account. The Frenchmen do so highly value, and are so fond of, the partridge, that if they be wanting, they utterly slight and despise the best-spread tables; as if there could be no feast without them." But however this might be in the times of our historian, the partridge is now too common in France to be considered as a delicacy; and this, as well as every other simple dish, is exploded for luxuries of a more compound invention.

In England, where the partridge is much scarcer, and a great deal dearer, it is still a favourite delicacy at the tables of the rich; and the desire of keeping it to themselves, has induced them to make laws for its preservation, no way harmonizing with the general spirit of English legislation. What can be more arbitrary than to talk of preserving the game; which, when defined, means no more than that the poor shall abstain from what the rich have taken a fancy to keep for themselves? If these birds could, like a cock or a hen, be made legal property, could they be taught to keep within certain districts, and only feed on those grounds that belong to the man whose entertainments they improve, it then might, with some show of justice, be admitted, that as a man fed them, so he might claim them. But this is not the case; nor is it in any man's power to lay a restraint upon the liberty of these birds, that, when let loose, put no limits to their excursions. They feed every where; upon every man's ground; and no man can say these birds are fed only by me. Those birds which are nourished by all, belong to all; nor can any one man, or any set of men, lay claim to them, when still continuing in a state of nature.

I never walked out about the environs of Paris, that I did not consider the immense quantity of game that was running almost

[1] This account is from the Journal Œconomique, and may be relied on.—*Goldsmith.*

tame on every side of me, as a badge of the slavery of the people; and what they wished me to observe as an object of triumph, I always regarded with a kind of secret compassion; yet this people have no game-laws for the remoter parts of the kingdom; the game is only preserved in a few places for the king, and is free in most places else. In England, the prohibition is general; and the peasant has not a right to what even slaves, as he is taught to call them, are found to possess.

Of partridges there are two kinds; the gray and the red.[1] The red partridge is the largest of the two, and often perches upon trees; the gray, with which we are best acquainted in England, is most prolific, and always keeps on the ground.

The partridge seems to be a bird well known all over the world, as it is found in every country, and in every climate; as well in the frozen regions about the pole, as the torrid tracts under the equator. It even seems to adapt itself to the nature of the climate where it resides. In Greenland, the partridge, which is brown in summer, as soon as the icy winter sets in, begins to take a covering suited to the season; it is then clothed with a warm down beneath; and its outward plumage assumes the colour of the snows amongst which it seeks its food. Thus it is doubly fitted for the place by the warmth and the colour of its plumage; the one to defend it from the cold, the other to prevent its being noticed by the enemy. Those of Baraconda, on the other hand, are longer legged, much swifter of foot, and choose the highest precipices and rocks to reside in.

They all, however, agree in one character, of being immoderately addicted to venery; and, as some writers affirm, often to an unnatural degree. It is certain the male will pursue the hen even to her nest; and will break her eggs, rather than not indulge his inclinations. Though the young ones have kept together in flocks during the winter, when they begin to pair in spring, their society disperses, and combats, very terrible with respect to each other, ensue. Their manners, in other circumstances, resemble all those of poultry in general: but their cunning and instincts seem superior to those of the larger kinds. Perhaps, as they live in the very neighbourhood of their enemies, they have more frequent occasion to put their little arts in practice; and learn, by habit, the means of evasion or safety. Whenever, therefore, a dog, or other formidable animal, approaches their nest, the female uses every means to draw him away. She keeps just before him, pretends to be incapable of flying, just hops up, and then falls down before him, but never goes off so far as to discourage her pursuer. At length, when she has drawn him entirely away from her secret treasure, she at once takes wing, and fairly leaves him to gaze after her in despair.

After the danger is over, and the dog withdrawn, she then calls her young, who assemble at once at her cry, and follow where she leads them. There are generally from ten to fifteen in a covey; and, if unmolested, they live from fifteen to seventeen years.

There are several methods of taking them, as is well known; that by which they are taken in a net with a setting dog, is the most pleasant, as well as the most secure. The dog, as every body knows, is trained to this exercise by a long course of education: by blows and caresses he is taught to lie down at the word of command; a partridge is shown him, and he is then ordered to lie down; he is brought into the field, and when the sportsman perceives where the covey lies, he orders his dog to crouch; at length the dog, from habit, crouches wherever he approaches a covey; and this is the signal which the sportsman receives for unfolding, and covering the birds with his net. A covey thus caught, is sometimes fed in a place proper for their reception; but they can never be thoroughly tamed, like the rest of our domestic poultry.[2]

[1] Modern ornithologists have ascertained many more varieties of partridges. The *Greek Partridge* is more bulky than the red, with which it has frequently been confounded. The *Painted Partridge* is a beautiful species belonging to India. See Plate XVIII. fig. 20.

[2] Partridge shooting is one of the most esteemed sports of the British fowler; and when pursued in a sportsman-like manner, with finely bred dogs, is of considerable interest. The county of Norfolk has been long celebrated for the number of its partridges, as well as for her zealous agriculturist, Mr Coke, one of the first shots in the kingdom. The following account from Pierce Egan's anecdotes, will give some idea both of the abundance of the partridge, and the excess to which the sport may be carried.

"The bet between Mr William Coke and Lord Kennedy, was for 200 sovereigns a-side, play or pay, who shot and bagged the greatest number of partridges in two days sporting; both parties to shoot on the same days, the 26th of September 1823, and the 4th of October in the same season. Mr William Coke to sport upon his uncle's manors in Norfolk; and Lord Kennedy in any part of Scotland he pleased. The result of Mr Coke's first day's shooting was eighty and a half brace of birds bagged. On Saturday, October 4, Mr W. Coke took the field soon after six o'clock in the morning: he was accompanied by his uncle, T. W. Coke, Esq. M. P., and by two umpires: Colonel Dixon for Mr Coke, and F. S. Blunt, Esq. for Lord Kennedy; also by two of his friends, Sir. H. Goodrich, Bart., and F. Hollyhocke, Esq. He was attended by several gamekeepers, and by one dog only to pick up the game. Several respectable neighbouring yeomen volunteered their services in assisting to beat for game, and rendered essential service throughout the day. Mr Coke sported over part of the Wigton and Egmere manors. The morning was foggy, and the turnips were so wet that the birds would not lie among them. Very little execution was done, in con-

CHAP. X.

THE QUAIL.

The last of the poultry kind that I shall mention, is the quail; a bird much smaller than any of the former, being not above half the size of a partridge. The feathers of the head are black, edged with rusty brown; the breast is of a pale yellowish red, spotted with black; the feathers on the back are marked with lines of a pale yellow, and the legs are of a pale hue. Except in the colours thus described, and the size, it every way resembles a partridge in shape; and, except that it is a bird of passage, all others of the poultry kind, in its habits and nature.[1]

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sequence, in the early part of the day; in the two first hours only six brace of birds were bagged. The day cleared up after eight o'clock, and the sportsman amply made up for his lost time. He found birds plentiful among Mr Denny's fine crop of turnips on the Egmere farm, and in one and twenty acre breck of Swedes, he bagged thirty-five and a half brace of birds. He concluded his day's sport soon after six in the evening, and had then bagged eighty-eight brace of birds, and five pheasants; but a dispute having arisen among the umpires about one bird, Colonel Dixon gave the point up, and the number was ultimately declared to be eighty-seven and a half brace of birds bagged; pheasants and other game not counted in the match: so that Mr W. Coke's number of birds bagged in the two days shooting, stands 173 brace. He had much fewer shots in the second than in the first day, but he shot better, as will be seen from the comparative number of birds bagged. On Saturday he bagged 180 birds from 327 shots, which was considered good shooting in a match of this nature, when a chance, however desperate it may appear, is not to be thrown away. His uncle, T. W. Coke, Esq. loaded a great part of the gun on Saturday, and as a finale to the day's sport, shot at and killed the last bird, which his nephew had previously missed. Lady Ann Coke was in the field a great part of the day; her ladyship carried refreshments for the sportsmen in her pony gig. Lord Kennedy chose for the scene of his exploits Montreith, in Scotland, a manor belonging to Sir William Maxwell, considered equal to any lands in Scotland for rearing partridges. On the first day of trial his lordship bagged fifty, and on the second, eighty-two brace, being in all 132 brace of partridges in two days."

Varieties of the partridge frequently occur; the most common are those varied with white, which sometimes prevails through a whole covey. Specimens entirely of a cream-colour are also not unfrequent, and here, although the tint may be said to be uniform, the various markings of the plumage appear conspicuous in different lights, as if from a variation of the structure of the feathers.

The Mountain Partridge has been said to be more frequently found in alpine districts than in lowlands, but they are known to mingle occasionally with those of common plumage. The colour is remarkable to be assumed as a variety, though it is often, we may say, generally mingled with whitish or reddish-white. The whole plumage is of deep sienna-brown, and this colour, somewhat like that of the common grouse, prevails in many species entirely upon the breast, lower parts, and shoulders. The specimens are generally less than those of ordinary plumage.

The partridge, therefore, seems to have a more extensive range of variation than almost any bird we are acquainted with, and according to Temminck and some other authors, is somewhat influenced by almost every change of climate. Those broods which frequent and are bred on the marshy grounds of the Zuyder Zee and mouth of Meuse are less in size and of a duller tint than those found in the drier lands of Belgium. Dry or parched districts, abundance of food and water, will always influence their condition, and it is to the same causes, with variation of climate that Temminck attributes the migrations of the partridge on some parts of the continent, and which are also said to be of a smaller size than those which do not migrate. This migratory bird has by some been also raised to the rank of a species, and named the Damascus partridge. By the modern ornithologists of this country, it is very little known, or its claims upon which even the variety rests ascertained, beyond the fact of its migration. And our latest, or indeed only authority from actual examination, is that of Temminck, who says that among many individuals he has been able to discover no good distinctions.—*Naturalist's Library, by Sir W. Jardine. Vol. IV.*

[1] The quails, forming the genus *Coturnix* of moderns, are at first sight so similar to the partridges, that they are not to be distinguished without a knowledge of their habits, and examination of their forms. In the bill and legs there are slight modifications, but the form of the wing is quite different, the first three quills being longest, while in the partridges the third is the longest, and a rounded wing of less power is the consequence. It may be recollected that, though the partridges were said to migrate in some countries, the migration is comparatively very partial, and often only from one part of a continent to another; on the other hand, almost all the quails migrate to a certain distance, and hence perform lengthened journeys often across the seas. In their habits they also show considerable difference, as they never perch. They often assemble in large flocks after the breeding season: and although they pair regularly, so soon as the female commences to sit, she is left alone, and the male attends no longer, nor afterwards assists in protecting the brood. They delight in cultivated countries, and never frequent woods. They are found in Europe, Asia, Africa, and New Holland.

The common quail seems to be generally distributed over the old world, though, in the south of Europe, it is perhaps as abundant as elsewhere. In Britain they may now be termed only an occasional visitant, the numbers of those which arrive to breed having considerably decreased, and they are to be met with certainty only in some of the warmer southern or midland counties of England. Thirty years since they were tolerably common and regular in their returns; and even in the south of Scotland a few broods were occasionally to be found. In these same districts they are now very uncertain. We have known of broods twice, and occasionally have shot a straggler apparently on its way to the south. They are extremely difficult to flush after the first time. The nest is made by the female, but, like the partridges, the eggs are deposited almost on the bare ground; these, also, unlike the uniform tint which we find prevailing in those of the true partridges, are deeply blotched with oil-green, and, except in form, are somewhat similar to those of the snipe. In France they are very abundant; and besides supplying the markets of that country, thousands are imported alive by the London poulterers, and fattened for the luxury of the metropolis.

They are taken by nets, into which they are decoyed by imitating their call. On the coast of Italy and Sicily, and all the Greek islands, they arrive at certain seasons in immense numbers. An hundred thousand are said to have been taken in one day. They are run

The quail is by all known to be a bird of passage; and yet if we consider its heavy manner of flying, and its dearth of plumage, with respect to its corpulence, we shall be surprised how a bird so apparently ill qualified for migration, should take such extensive journeys. Nothing, however, is more certain: "When we sailed from Rhodes to Alexandria," say Bellonius, "about autumn, many quails, flying from the north to the south, were taken in our ship; and sailing at spring-time, the contrary way, from the south to the north, I observed them on their return, when many of them were taken in the same manner." This account is confirmed by many others; who aver, that they choose a north wind for these adventures; the south wind being very unfavourable, as it retards their flight, by moistening their plumage. They then fly two by two; continuing, when their way lies over land, to go faster by night than by day; and to fly very high, to avoid being surprised or set upon by birds of prey. However, it still remains a doubt whether quails take such long journeys as Bellonius has made them perform. It is now asserted by some, that the quail only migrates from one province of a country to another. For instance, in England, they fly from the inland counties, to those bordering on the sea, and continue there all the winter. If frost or snow drive them out of the stubble-fields or marshes, they then retreat to the sea-side, shelter themselves among the weeds, and live upon what is thrown up from the sea upon shore. Particularly in Essex, the time of their appearance upon the coasts of that country exactly coincides with their disappearance from the more internal parts of the kingdom; so that what has been said of their long flights, is probably not so well founded, as is generally supposed.

These birds are much less prolific than the partridge; seldom laying more than six or seven whitish eggs, marked with ragged rush-coloured spots. But their ardour in courtship yields scarcely to any other bird, as they are fierce and cruel at the season to each other, fighting most desperately, and (a punishment they richly deserve) being at that time very easily taken. Quail-fighting was a favourite amusement among the Athenians: they abstained from the flesh of this bird, deeming it unwholesome, as supposing that it fed upon the white hellebore; but they reared great numbers of them, for the pleasure of seeing them fight; and staked sums of money, as we do with regard to cocks, upon the success of the combat. Fashion, however, has at present changed with regard to this bird; we take no pleasure in its courage, but its flesh is considered as a very great delicacy.

Quails are easily caught by a call; the fowler, early in the morning, having spread his net, hides himself under it among the corn; he then imitates the voice of the female with his quail-pipe, which the cock hearing, approaches with the utmost assiduity; when he has got under the net, the fowler then discovers himself, and terrifies the quail, who attempting to get away, entangles himself the more in the net, and is taken. The quail may thus very well serve to illustrate the old adage, that every passion, carried to an inordinate excess, will at last lead to ruin. (For Welcome Quail, see Plate XVIII. fig. 16.)

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after during the flight like the passenger pigeons of America, and a harvest is gathered when the numbers are greatest. In Sicily, crowds of all ages and degrees assemble on the shore. The number of boats is even greater; and enviable is the lot of the idle apprentice, who, with a borrowed musket or pistol, no matter how unsafe, has gained possession of the farthest rock, where there is but room for himself and his dog, which he has fed with bread only, all the year round, for these delightful days, and which sits in as happy expectation as himself for the arrival of the quails. Ortygia was named from them; and so abundant were they on Capri, an island at the entrance of the Gulf of Naples, that they formed the principal revenue of the bishop of the island. From twelve to sixty thousand were annually taken; and one year the capture amounted to one hundred and sixty thousand. In China, and in many of the eastern islands, and Malacca, they are also very abundant, performing regular migrations from the interior to the coast. Here they are domesticated along with a small species of Ortygis, and trained to fight. Large stakes are risked upon the result, as in the cockpit. They are also used by the Chinese to warm their hands in cold weather, their bodies being thought to contain a large proportion of animal heat, from the pugnacious disposition of their tempers.

The common quail has the crown of the head and back of the neck black, each feather margined with chestnut; and down the centre of the head and neck there is a cream-yellow streak. Over each eye, and proceeding down the neck, is a white streak: chin and throat chestnut-brown, mixed with blackish-brown. Back scapulars and wing-coverts black, the feathers margined and varied with brown, and each having its shaft and central parts sienna-yellow. The breast and belly are pale buff or orange, the shafts and margins of the feathers yellowish-white. Tail blackish-brown, with the shafts, tips, and base cream-yellow. In the female there is no black or brown on the neck and throat. Her breast is spotted with blackish-brown, and the general tints of her plumage are paler. Pure white or spotted varieties sometimes occur.—*Naturalist's Lib. Vol. IV.*

HISTORY OF BIRDS.

BOOK IV.

OF BIRDS OF THE PIE KIND.

CHAP. I.

OF BIRDS OF THE PIE KIND.

In marshalling our army of the feathered creation, we have placed in the van a race of birds long bred to war, and whose passion is slaughter; in the centre we have placed the slow and heavy laden, that are usually brought into the field to be destroyed; we now come to a kind of light infantry, that partake something of the spirit of the two former, and yet belonging to neither. In this class we must be content to marshal a numerous irregular tribe, variously armed, with different pursuits, appetites, and manners; not formidably formed for war, and yet generally delighting in mischief, not slowly and usefully obedient, and yet without any professed enmity to the rest of their fellow tenants of air.

To speak without metaphor; under this class of birds we may arrange all that noisy, restless, chattering, teazing tribe, that lies between the hen and the thrush, that, from the size of the raven down to that of the woodpecker, flutter round our habitations, and rather with the spirit of pilferers than of robbers, make free with the fruits of human industry.

Of all the other classes, this seems to be that which the least contributes to furnish out the pleasures, or supply the necessities of man. The falcon hunts for him; the poultry tribe supplies him with luxurious food; and the little sparrow race delight him with the melody of their warblings. The crane kind make a studied variety in his entertainments; and the class of ducks are not only many of them delicate in their flesh, but extremely useful for their feathers. But in the class of the pie kind, there are few, except the pigeon, that are any way useful. They serve rather to teaze man, than to assist or amuse him. Like faithless servants, they are fond of his neighbourhood, because they mostly live by his labour; but their chief study is what they can plunder in his absence, while their deaths make no atonement for their depredation.

But though, with respect to man, this whole class is rather noxious than beneficial; though he may consider them in this light, as false, noisy, troublesome neighbours, yet, with respect to each other, no class of birds are so ingenious, so active, or so well fitted for society. Could we suppose a kind of morality among birds, we should find that these are by far the most industrious, the most faithful, the most constant, and the most connubial. The rapacious kinds drive out their young before they are fit to struggle with adversity; but the pie kind cherish their young to the last. The poultry class are faithless and promiscuous in their courtship; but these live in pairs, and their attachments are wholly confined to each other. The sparrow kind frequently overleap the bounds of nature, and make illicit varieties; but these never. They live in harmony with each other; every species is true to its kind, and transmits an unpolluted race to posterity.

As other kinds build in rocks or upon the ground, the chief place where these build is in trees or bushes; the male takes his share in the labours of building the nest, and often relieves his mate in the duties of incubation. Both take this office by turns; and when the young are excluded, both are equally active in making them an ample provision.

They sometimes live in societies; and in these there are general laws observed, and a kind of republican form of government established among them. They watch not only for the general safety, but for that of every other bird of the grove. How often have we

seen a fowler, stealing in upon a flock of ducks or wild geese, disturbed by the alarming note of a crow or a magpie: its single voice gave the whole thoughtless tribe warning, and taught them in good time to look to their safety.

Nor are these birds less remarkable for their instincts than their capacity for instruction. There is an apparent cunning or archness in the look of the whole tribe; and I have seen crows and ravens taught to fetch and carry with the docility of a spaniel. Indeed, it is often an exercise that, without teaching, all this tribe are but too fond of. Every body knows what a passion they have for shining substances, and such toys as some of us put a value upon. A whole family has been alarmed at the loss of a ring; every servant has been accused, and every creature in the house, conscious of their own innocence, suspected each other; when, to the utter surprise of all, it has been found in the nest of a tame magpie or a jackdaw, that nobody had ever thought of.

However, as this class is very numerous, it is not to be supposed that the manners are alike in all. Some, such as the pigeon, are gentle and serviceable to man; others are noxious, capricious, and noisy. In a few general characters they all agree; namely, in having hoarse voices, slight active bodies, and a facility of flight, that baffles even the boldest of the rapacious kinds in the pursuit. I will begin with those birds which most properly may be said to belong to this class, and go on till I finish with the pigeon, a harmless bird, that resembles this tribe in little else except their size, and that seems to be the shade uniting the pie and the sparrow kind into one general picture.

It is not to be expected that in this sketch of the great magazine of nature, we can stop singly to contemplate every object. To describe the number that offers would be tedious, and the similitude that one bears to another would make the history disgusting. As a historian in relating the action of some noble people does not stop to give the character of every private man in the army, but only of such as have been distinguished by their conduct, courage, or treachery; so should the historian of nature only seize upon the most striking object before him; and having given one common account of the most remarkable, refer the peculiarities of the rest to their general description.

CHAP. II.

OF THE RAVEN, THE CROW, AND THEIR AFFINITIES.[1]

The Raven, the Carrion-crow, and the Rook, are birds so well known, that a long descrip-

[1] Five species of the genus Corvus occur in Britain:—the raven, the carrion-crow, the hooded-crow, the rook, and the jackdaw. They are all permanently resident. The magpie differs so much from the rest in the elongation of the tail, the comparative shortness of the wings, and some other circumstances, that several writers have referred it to a separate genus; but the bill, the feet, and the organs in general, are so similar, that there would be little reason for setting it apart, were there not other species having more dissimilar features. Each species differs greatly in many of its habits, so that I am unable, from my own observation, to arrive at more general conclusions than those given above. In fact, every species in existence has peculiarities both in habits and structure, which render extended generic characters, applicable to all the beings in an assumed group, impossible.

The *raven*, (see Plate XV. fig. 7.) which is the largest species of the crow family, is one of the most remarkable of our native birds, both on account of its habits, and its historical, superstitious, and economical relations. With a grave and dignified air it combines great sagacity, and in courage is not much inferior even to some of the rapacious birds.

It is crafty, vigilant, and shy, so as to be with great difficulty approached, unless in the breeding season, when its affectionate concern for its young in a great measure overcomes its habitual dislike to the proximity of man,—a dislike which is the result of prudence more than of mere timidity, for under particular circumstances it will not hesitate to make advances which a timorous bird would no doubt deem extremely hazardous. Either from natural instinct, or from observation and reflection, it appears to know in some measure the power of its arch enemy; and finding that its own faculties are insufficient to enable it to counteract his destructive propensities, carefully avoids coming within his reach. On the other hand it eats from off the same carcase as a dog, and takes its station close to an otter devouring its prey, doubtless because its vigilance and activity suffice to enable it to elude their efforts to inflict injury upon it; and while it yields to the eagle, it drives away the hooded crow and the gull. It knows the distance too at which it is safe from a man armed with a gun, and allows the shepherd and his dogs to come much nearer than the sportsman.

When searching for food on the ground, it generally walks with a steady and measured pace, like the carrion-crow, the hooded-crow, and the rook; but under excitement it occasionally leaps, using its wings at the same time, as when driven from carrion by a dog, or when escaping from its fellows with a fragment of flesh or intestine. Its flight is commonly steady and rather slow, and is performed by regularly-timed beats of its extended wings, the neck and feet being retracted; but it can urge its speed to a great degree of rapidity, so as to overtake an eagle or even a hawk, when passing near its nest. In fine weather it often soars to a vast height, in the manner of the birds just mentioned, and floats as it were at ease high over the mountain tops. Some naturalists observing birds thus engaged, have imagined them to be searching for food, and have consequently amused their readers with marvellous accounts of the distances at which the eagle can spy its prey; but had

tion would but obscure our ideas of them. The raven is the largest of the three, and distinguished from the rest not only by his size, but by his bill being somewhat more hooked than that of the rest. As for the carrion-crow and the rook, they so strongly resemble each other, both in make and size, that they are not easily distinguished asunder. The chief difference

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they patiently watched, they might have found that the quiet soarings of the raven and the rapacious species have no reference to prey. On the other hand, it may sometimes be observed gliding along, and every now and then shifting its course, in the heaviest gales, when scarcely another bird can be seen abroad. Although there is not much reason for calling it "the tempest-loving raven," it would be a severe storm indeed that would keep it at home when a carcase was in view.

Having enjoyed ample opportunities of cultivating an acquaintance with this species in the outer Hebrides, I shall describe its manners as observed by me in those dreary, but to the naturalist, highly interesting islands. There the raven, in search of food, may be seen, either singly or in pairs, in all sorts of situations, along the rocky shores, on the sand fords, the sides of the hills, the inland moors, and the mountain tops. It flies at a moderate height, proceeding rather slowly, deviating to either, sailing at intervals, and seldom uttering any sound. When it has discovered a dead sheep, it alights on a stone, a peat bank, or other eminence, folds up its wings, looks around, and croaks. It then advances nearer, eyes its prey with attention, leaps upon it, and in a half-crouching attitude examines it. Finding matters as it wished, it croaks aloud, picks out an eye, devours part of the tongue if that organ be protruded, and lastly attacks the subcaudal region. By this time another raven has usually come up. They perforate the abdomen, drag out and swallow portions of the intestines, and continue to feast until satiated or disturbed. Sometimes, especially should it be winter, they are joined by a great black-backed gull, or even a herring gull, which, although at first shy, are allowed to come in for a share of the plunder; but should an eagle arrive, both they and the gulls retire to a short distance, the former waiting patiently, the latter walking backwards and forwards uttering plaintive cries, until the intruder departs. When the carcase is that of a larger animal than a sheep, they do not however fly off, although an eagle or even a dog should arrive. "Feris convivialis," observes Linnæus, and the fact is proverbial in the Hebrides, where this bird is named Biadhtach, and where biadhtachd, which etymologically is analogous to ravening, signifies associating for the purpose of eating and making merry. These observations I have made while lying in wait in little huts constructed for the purpose of shooting eagles and ravens from them. The latter I have allowed to remain unmolested for hours, that they might attract the former to the carrion; and in this manner I have been enabled to watch their actions when they were perfectly unrestrained.

Although the raven is omnivorous, its chief food is carrion, by which is here meant the carcases of sheep, horses, cattle, deer, and other quadrupeds, dolphins and cetaceous animals in general, as well as fishes that have been cast ashore. In autumn it sometimes commits great havock among the barley, and in spring it occasionally destroys young lambs. It has also been accused of killing diseased sheep by picking out their eyes; but of this I have obtained no satisfactory evidence. It annoys the housewives by sometimes flying off with young poultry, and especially by breaking and sucking eggs which the ducks or hens may have deposited, as they frequently do, among the herbage.

In these islands, should a horse or a cow die, as in my younger days was very frequently the case in the beginning of summer, after a severe winter or spring, or should a grampus or other large cetaceous animal be cast on the shore, the ravens speedily assemble, and remain in the neighbourhood until they have devoured it. A large herd of grampuses, delphinus orca, having been driven by the inhabitants of Pabbay on the sand beach of that island, which is one of those in the Sound of Harris, an amazing number of ravens soon collected from all quarters, and continued for several weeks to feast upon the carcases. By the time when this supply of food was exhausted, autumn was advancing, and the inhabitants became alarmed lest, should the ravens prolong their stay, they should attack their barley, which was their main stay, as they depended chiefly upon it for the means of paying their rents, a regular system of illicit distillation having, for reasons not difficult to be guessed, been permitted for many years. Various expedients were tried in vain, until at length a scheme was devised by one Finlay Morison which produced the desired effect. The ravens retired at night to a low cliff on the east side of the island, where they slept crowded together on the shelves. Finlay and a few chosen companions, intimately acquainted with the principal fissures and projections of the rock, made their way after midnight to the roosts of the ravens, caught a considerable number of them, and carried them off alive. They then plucked off all their feathers excepting those of the wings and tail, and in the morning when their companions were leaving their places of repose, let loose among them these live scare-crows. The ravens, terrified by the appearance of those strange-looking creatures, which it seems they failed to recognize as their own kinsfolk, betook themselves to flight in a body, and did not return to the island. It was in this numerous congregation of ravens that the white individual of which I have already made mention occurred, and which the people, considering it as the royal bird, regarded with a kind of superstitious reverence. On another occasion, when a whale had been cast ashore on the farm of Big Scarista, I have seen these birds impatiently waiting on the rocks around, until the people who were flencing it went home, carrying creels full of the flesh with them for domestic consumption, when the ravens descended to the carcase, and gorged themselves with all haste.

The voice of the raven is a hoarse croak, resembling the syllable *Crock* or *Cruck*; but it also emits a note not unlike the sound of a sudden gulp, or the syllable *Cluck*, which it seems to utter when in a sportive mood; for although ordinarily grave, the raven sometimes indulges in a frolic, performing somersets and various evolutions in the air, much in the manner of the rook.

Taken from the nest when nearly able to fly, the raven is easily reared, very soon learns to feed by itself, and becomes an amusing, although occasionally mischievous pet. It defends itself against dogs and cats with great courage and success, and may be taught to pronounce words with considerable accuracy. Numerous stories are told of its thieving propensities; but let one suffice: "We have been assured," says Montagu, "by a gentleman of veracity, that his butler having missed a great many silver spoons and other articles, without being able to detect the thief for some time, at last observed a tame raven with one in his mouth, and watched him to his hiding-place, where he found more than a dozen."

I know no British bird possessed of more estimable qualities than the raven. His constitution is such as to enable him to brave the fury of the most violent tempests, and to subsist amidst the most intense cold; he is strong enough to repel any bird of his own size, and his spirit is such as to induce him to attack even the eagle; his affection towards his mate and young is great, although not superior to that manifested by many other

to be found between them lies in the bill of the rook; which, by being frequently thrust into the ground to fetch out grubs and earth-worms, is bare of feathers as far as the eyes, and appears of a whitish colour. It differs also in the purple splendour or gloss of its feathers, which in the carrion-crow are of a dirty black. Nor is it amiss to make those distinc-

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birds; in sagacity he is not excelled by any other species; and his power of vision is at least equal to that of most others, not excepting the birds of prey, for he is generally the first to discover a carcase. To man, however, he seems to be more injurious than useful, as he is accused of killing sickly sheep, sometimes destroys lambs, and frequently carries off the young and eggs of domestic poultry. For this reason he is generally proscribed, and in many districts a price is put upon his head; but his instinct and reason suffice to keep the race from materially diminishing. As his flesh is not palatable, it is not probable that he could be useful in the domestic state. He seems to have fewer feathered enemies than most other birds; for although he may often be seen pursuing gulls, hawks, and eagles, I have never observed any species attacking him, with the exception of the domestic cock, which I have seen give battle to him, and even drive him off. It has been alleged, however, that rooks assail him in defence of their young, and there is nothing incredible in this, for the weakest bird will often in such a case attack the most powerful and rapacious.

The *carrion-crow* is so intimately allied to the raven,



that, without considering its inferior size, and some differences in the forms of the feathers, one might be apt to confound the two species. Its proportions are almost the same as those of the raven, the body being ovate, rather full and compact; the neck short and strong; the head large, oblong, and somewhat convex above.

The carrion-crow is very uncommon in the northern and middle parts of Scotland; but in the southern division of that country, and in England, is much more numerous than the raven or the hooded-crow. It roosts in trees and on rocks, betakes itself in search of food to the open moors, hilly pastures, fields, and shores, and preys on small quadrupeds, young hares and rabbits, young birds, eggs, crustacea, mollusca, worms, grubs, and grain. Its principal food however is carrion of all kinds; and it not unfrequently destroys young lambs and sickly sheep. Montagu states that he has seen it pursue a pigeon, and strike one dead from the top of a barn. As a proof of its being occasionally granivorous, like the raven, I may mention that I found the stomach of one that had been trapped in Linlithgowshire in November 1834, filled with oat seeds.

The crow is in general a solitary bird, or rather keeps in pairs, although, when there is an abundant supply of food, several individuals may occasionally be seen together. Its flight is similar to that of the raven, being generally sedate and direct, performed by regularly-timed flaps, the wings stretched out to their full extent, so that the outer primaries are separated for nearly half their length. Its mode of walking is also similar, and its cry is a croak, clearer and less sonorous than that of the raven. At a distance it is not easily distinguishable from the rook; but one who attends to small differences of form and habits may readily distinguish the two species. The rook is less compact, and the feathers of its abdominal region project more, while its mode of walking is quicker, and it keeps its bill more inclined towards the ground. At hand, the species are very easily distinguished, the rook having a bill of a different form, and the feathers at its base being abraded. Although it is said by several ornithologists to breed with the carrion-crow, and has even been considered by some to be of the same species, I have never seen it consorting with that bird, even casually.

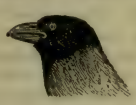
It nestles in rocks and tall trees, beginning as early as February to construct or repair its nest, which is bulky, composed of twigs, and lined with moss, straws, wool, hair, and other soft materials. The eggs are from four to six, of a rather elongated ovate form, pale bluish-green, spotted and blotched with dark umber or clove-brown and purplish-grey. Sometimes the eggs are nearly destitute of spots, and occasionally they are closely freckled all over with light brown.

This species is easily distinguished from the raven, by its inferior size, and the shortness of the anterior cervical feathers. From the rook it is still more easily distinguished, the bristly feathers over the bill remaining entire in it, while in that bird they are abraded; the texture and tints of the plumage are also different, as will be seen on comparing the descriptions. The carrion-crow is much more nearly allied to the American crow, Corvus Americanus, with which it had been considered identical, until the differences were pointed out by Mr Audubon; (see Ornith. Biogr. vol. ii. p. 323.) I have carefully compared skins of the two species, and am convinced that they are different.

It is easily tamed, and in a state of domestication shows the same thieving propensities as the raven and jackdaw, carrying off to some hiding-place whatever articles strike its fancy. In activity and liveliness he is intermediate between the birds just mentioned; like them he may be taught to imitate the human voice; and his actions afford amusement to those who are fond of feathered pets, as he becomes very familiar with his friends, repels his canine foes, and contrives to console himself for the loss of liberty in the best way he can, although if his wings are left uncut he generally endeavours to regain his freedom.

According to Temminck, the carrion-crow is dispersed over the whole extent of Western Europe, but is rare in the eastern parts. It has not been found in America.

The *hooded-crow* is so closely allied to the carrion-



crow, that, were the colours the same in both, it would be almost impossible to distinguish them. Some persons indeed have considered the two as probably forming only a single species; but in this opinion I do not agree with them, for reasons to be presently stated. The general form and size are about the same as those of the species just mentioned. The bill is almost precisely similar, or, if different at all, it is perhaps not quite so robust.

The hooded-crow is very abundant in the Hebrides, the Shetland and Orkney Islands, and most parts of the northern and middle divisions of Scotland; but is rare in the southern division, and gradually diminishes as we proceed southward. It is not confined to the coast, but is met with in the very centre of the Grampians, and other inland districts; but in winter few individuals are found in the interior. Although somewhat more social than the carrion-crow or the raven, it is not gregarious, for although four or five individuals may often be seen together, more than that number seldom convene unless when attracted by an abundant supply of food. It de-

tions, as the rook has but too frequently suffered for its similitude to the carrion-crow; and thus a harmless bird, that feeds only upon insects and corn, has been destroyed for another that feeds upon carrion, and is often destructive among young poultry.

The manners of the raven and the carrion-crow are exactly similar; they both feed upon

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rives its subsistence from carrion, dead fish, crabs, echini, mollusca, larvæ, grain, and other matters, it being fully as promiscuous a feeder as the carrion-crow or the raven, although it certainly prefers fish and mollusca to large carcases, and very rarely feeds upon a stranded whale, or even a domestic animal. Young lambs are favourite delicacies, and in severe seasons, when summer in vain struggles with winter, sometimes afford an abundant temporary supply. I am not, however, inclined to believe that the hooded-crow often destroys these animals, nor that it ventures to attack sickly sheep. It never disputes a prize with the raven, much less the eagle, nor will it advance so near to a dog as the former of these birds, which it resembles in vigilance and cunning, but without showing equal boldness.

Perhaps the most remarkable habit of the hooded-crow is one which most persons who have observed it consider as indicative of the approach of rain, but which I have not found to have any connection with that phenomenon. In quiet, and more especially in dull close weather, one of them, perched on a stone or crag, continues to croak for a long time, being responded to at intervals by another that has taken a station at some distance. Its voice is not so loud or clear as that of the carrion-crow, but resolves itself into a rather harsh sound resembling the syllable *Craā*, pronounced by a genuine Aberdonian. On ordinary occasions, its flight is peculiarly sedate, being performed by regularly-timed slow beats; but when necessary, it can be greatly accelerated, although it never equals in rapidity that of the raven. It also walks in the same staid manner as the carrion-crow and the rook, and in general wears a grave aspect, demeaning itself so as if it were not disposed to indulge in unbecoming levity. It rarely molests other birds, nor is it often attacked by any.

In districts frequented by it, you commonly find it along the shore, sometimes among the rocks, searching for crabs and shell-fish, which it has sagacity enough, when it cannot otherwise open them, to raise in the air and drop to the ground; sometimes on the sandy beach, especially if fish or echini have been cast up. The latter are so frequently devoured by them in the Hebrides that they have obtained the name of hooded-crow's cups —cragan-feannaig. Gulls, even the strongest, rarely dispute with them on such occasions, but impatiently walk about until they choose to fly off.

Although familiar enough with this species, I have never observed it mount high into the air like the raven, for the purpose of sailing. Nor does it scour the hill tops and sides in the same free and bold manner, but rather has a skulking habit, and prefers remaining on the lower grounds, especially in the vicinity of water, whether fresh or salt. It searches the moors, however, for eggs and young birds, and commits considerable depredations upon those of the golden plover and red grouse. The eggs of gulls and terns it does not venture to seize upon, knowing that these birds would join in attacking any intruder.

It is said by some to assemble at times in very large flocks, apparently for the purpose of settling some important matter referring to their mutual benefit: but I have not observed any such conventions, and am disposed to consider them as merely imaginary. Nor is it necessary that they should have assemblies for the purpose of choosing partners, for, according to my observation, they remain paired all the year, and the young individuals can easily meet without having a general convocation. Several authors talk of their building in trees; but I have never seen a hooded-crow's nest elsewhere

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than on a rock, and generally by the sea. It is large, composed of twigs, sea-weeds, heath, feathers, and straws, being similar to that of the carrion-crow and raven. The eggs, from four to six or seven in number, but generally five, are of a regular ovate form, from an inch and a half to an inch and eight twelfths long, and about one and a twelfth across; of a pale bluish-green tint, marked all over, but more thickly at the large end, with oblong and roundish spots of greenish-brown and pale purplish-gray. They vary considerably in colour, as is the case with the other species, and in a cabinet cannot be distinguished from those of the carrion-crow. The young are at first covered with blackish-gray down.

According to authors, this species occurs in all parts of Europe, remaining stationary in the eastern and mountainous districts, but, as M. Temminck alleges, appearing only in September and October in the western countries. In the whole of Scotland it is stationary all the year, although many individuals may probably migrate southward; but in most parts of England it appears in October, chiefly along the coast, and on the extensive maritime downs, and departs in March.

The *rook* is more slender and generally somewhat



smaller than the carrion-crow, which it greatly resembles when viewed at a distance. The general form, however, is moderately full.

All day long you may find the rook in the fields or pastures, diligently searching for worms and grubs, breaking up and turning over the dry cow-dung with its bill, thrusting it deep into the loose soil, or digging among tufts of grass and clover to extract the larvæ that find harbour amidst their roots. At this season, you often observe these birds scattered over the moorland haunts of the curlew and plover, and not unfrequently on the sandy or muddy beaches exposed by the tide. Towards evening, collecting into large straggling flocks, and uttering their loud and not unpleasant cries, they return to their roosts on the tall trees of some antique mansion, where for ages, perhaps, their race has fixed its abode. During long droughts they experience great difficulty in procuring subsistence, at least in districts where there is not a diversity of soil and a variety of scenery, although in most parts of Scotland they have a choice of ground which renders them less liable to be seriously incommoded by extremes of weather.

In their distant flights they commonly proceed at a considerable height, moving with moderate speed, in a straggling disorderly band, often, especially at the outset, with much noise. Their flight is of that kind which I call sedate, being performed by regularly-timed rather slow beats of the expanded wings, direct, without undulations, and capable of being greatly protracted. Sometimes on one of their excursions, when passing over a field or meadow at a great height, something in it appears suddenly to attract their attention, and they descend headlong, performing singular evolutions as they

carrion; they fly only in pairs; and will destroy other birds, if they can take them by surprise. But it is very different with the rook, the daw, and the Cornish chough, which may be all ranked in this order. They are sociable and harmless; they live only upon insects and grain; and wherever they are, instead of injuring other birds, they seem sentinels for the whole

turn from side to side and wind among each other. In general, however, they settle with more caution, sometimes flying repeatedly over the ground, often dropping down one by one, and occasionally perching for a while in the neighbouring trees before venturing to alight.

The cry of the rook resembles the syllable *Khraa*, more or less harsh or soft according to occasion. There is great diversity in the voice of individuals, some having much louder and clearer notes than others. Although separately their cries are monotonous and disagreeable, yet from a large flock, and at some distance, they are by no means unpleasant; and those who have become habituated to the noise of a rookery, do not generally find it annoying.

Although the staple food of the rook is larvæ and worms, it also eats shell-fish, crustacea, coleopterous insects, lizards, seeds, especially of cereal plants, acorns, beech-nuts, portions of roots of grasses, and in winter even turnips. I have seen rooks picking at a fish on the beach, but I believe they never devour carrion, although they may be seen about a dead horse or cow searching for larvæ. While feeding, they freely associate with jackdaws, and even gulls; and I have seen starlings, red-wings, fieldfares and missel thrushes mingling with them without much apprehension of danger.

Rooks are not easily shot in the fields unless one come accidentally upon some that have straggled to the edge, for they are commonly shy and vigilant. At the same time they seem to calculate upon the protection which they usually receive in the neighbourhood of their breeding places, and are less shy on the lawn and in the park than on the distant pastures and in the ploughed fields. In the neighbourhood of towns they are always more wary than in the country, so that holding out a gun or a stick, or even the arm, or standing stock still, is sure to make them fly off, unless they be several hundred yards distant.

In form the *jackdaw* is more compact, and in action



more lively, than any other British bird of the genus. It is about the size of the domestic pigeon, with the body ovate, the neck rather short, the head large, the feet, wings, and tail of moderate length.

The jackdaw is a remarkably active, pert, and loquacious little fellow, ever cheerful, always on the alert, and ready either for business or frolic. If not so respectable as the grave and sagacious raven, he is at least the most pleasant of the family, and withal extremely fond of society, for not content with having a flock of his own folk about him, he often thrusts himself into the midst of a gang of rooks, and in winter sometimes takes up his abode entirely with them.

The flight of this species is similar to that of the rook, somewhat more rapid, generally extremely wavering, the bird frequently shifting its direction, now dashing downwards, then curving up again, shooting obliquely to either side, and performing as many evolutions as if it could not follow a direct line, which, however, it sometimes does when in great haste. It is also extremely clamorous, and its note being loud and clear, resembling the syllable *Kae* or *Caw*, variously modulated, the noise emitted by a large flock, although in no degree musical, is far from being unpleasant.

Jackdaws inhabit deserted buildings, steeples, towers, and high rocks, especially those along the coast. Sallying from thence at early dawn, they betake themselves to the pastures, meadows, or ploughed fields, to search for larvæ, worms, insects, and in general the same sort of food as the rooks, with which they often associate on their excursions. They walk gracefully, and much more smartly than the rooks, often running under excitement, and frequently quarrelling together, although without any serious results. They do not despise carrion, and on the shore will occasionally feed on shell-fish, crustacea and fishes, being nearly as omnivorous as the hooded-crows, although giving a decided preference to larvæ. They are scarcely less vigilant than the rooks, at least while in the fields, so that it is not always easy to get within shot of them; but in the breeding season one may readily procure specimens by concealing himself in the midst of their haunts.

This is one of the few birds that habitually or occasionally reside in the heart of cities, where it selects a steeple, a church tower, or any other high building, in which it can find a sufficient number of secure retreats. In Edinburgh, for example, it frequents Heriot's and Watson's Hospitals, the University, the Infirmary, the Chapel of Holyroodhouse, and the Castle, although in the latter it is chiefly in the rock that it takes up its abode. In the country, ruinous castles are its favourite places of resort, and it is found, for example, at Dunottar, Rosslyn, and Tantallon Castles, and the buildings on the Bass. It also not unfrequently finds refuge in high rocks, as at the Cove near Aberdeen, and in other places along the coast; and in defect of more agreeable lodgings, will sometimes settle in a wood.

In these places also it nestles, as well as not unfrequently in the interior of chimneys in which fire is not kept. The nest is fixed in any convenient recess, on a cornice or other projecting part of a building, in the hole of a spout, or, in short, in any place that seems suitable. It has a base-work of sticks, on which is laid a quantity of straw, wool, feathers, and other soft materials. The eggs are from four to seven, generally five, of a regular oval form, broader in proportion to their length than those of the other species, much lighter also, being of a very pale greenish-blue, or rather bluish-white, covered, more profusely at the larger end, with small, round, separated spots of dark brown and pale purplish. They vary in length from an inch and four twelfths to an inch and six twelfths, in diameter from eleven and a half twelfths to a twelfth more. The eggs are generally deposited in May, and the young are abroad by the end of June.

Jackdaws often obtain a large proportion of their food in the streets, which they frequent more especially in the mornings, along with pigeons, and sometimes rooks. On these occasions they pick up the refuse of whatever serves as food to man. Like the starling and the magpie, they sometimes alight on sheep and cattle, apparently for the purpose of searching for the sticks and other animals among their hair. They are not so shy as rooks when in privileged places, enter a garden with little fear, and are easily enticed to a particular spot by placing food for them. Thus in towns, persons, for amusement, draw them to their windows, along with pigeons and sparrows; but they are always more suspi-

feathered creation. It will be proper, therefore, to describe these two sorts according to their respective appetites, as they have nothing in common but the very strong similitude they bear to each other in their colour and formation.

The raven is a bird found in every region of the world; strong and hardy, he is uninfluenced by the changes of the weather; and when other birds seem numbed with cold, or pining with famine, the raven is active and healthy, busily employed in prowling for prey, or sporting in the coldest atmosphere. As the heats at the line do not oppress him, so he bears the cold of the polar countries with equal indifference. He is sometimes indeed seen milk white; and this may probably be the effect of the rigorous climates of the north. It is most likely that this change is wrought upon him as upon most other animals in that part of the world, where their robes, particularly in winter, assume the colour of the country they inhabit. As in old age, when the natural heat decays, the hair grows gray, and at last white; so among these animals the cold of the climate may produce a similar languishment of colour, and may shut up those pores that conveyed the tincturing fluids to the extremest parts of the body.

However this may be, white ravens are often shown among us, which I have heard some say, are rendered thus by art; and this we could readily suppose, if they were as easily changed in their colour, as they are altered in their habits and dispositions. A raven may be reclaimed to almost every purpose to which birds can be converted. He may be trained up for fowling like a hawk; he may be taught to fetch and carry like a spaniel; he may be taught to speak like a parrot; but the most extraordinary of all is, that he can be taught to sing like a man. I have heard a raven sing the Black Joke with great distinctness, truth, and humour.

Indeed, when the raven is taken as a domestic, he has many qualities that render him extremely amusing. Busy, inquisitive, and impudent, he goes every where; affronts and drives off the dogs, plays his pranks on the poultry, and is particularly assiduous in cultivating the good will of the cook-maid, who seems to be the favourite of the family. But then, with the amusing qualities of a favourite, he often also has the vices and defects. He is a glutton by nature, and a thief by habit. He does not confine himself to petty depredations on the pantry or the larder; he soars at more magnificent plunder; at spoils that he can neither exhibit nor enjoy; but which, like a miser, he rests satisfied with having the satisfaction of sometimes visiting and contemplating in secret. A piece of money, a tea-spoon, or a ring, are always tempting baits to his avarice; these he will slily seize upon, and, if not watched, will carry to his favourite hole.

In his wild state, the raven is an active and greedy plunderer. Nothing comes amiss to him; whether his prey be living or long dead it is all the same, he falls to with a voracious appetite; and, when he has gorged himself, flies to acquaint his fellows, that they may participate of the spoil. If the carcase be already in the possession of some more powerful animal, a wolf, a fox, or a dog, the raven sits at a little distance, content to continue an humble spectator till they have done. If in his flights he perceives no hopes of carrion, and his scent is so exquisite that he can smell it at a vast distance, he then contents himself with more unsavoury food, fruits, insects, and the accidental dessert of a dunghill.

This bird chiefly builds its nests in trees, and lays five or six eggs, of a pale green colour, marked with small brownish spots. They live sometimes in pairs, and sometimes they frequent, in great numbers, the neighbourhood of populous cities, where they are useful in devouring those carcases that would otherwise putrefy and infect the air. They build in high trees or old towers, in the beginning of March with us in England, and sometimes sooner, as the spring is more or less advanced for the season. But it is not always near towns that they fix their retreats; they often build in unfrequented places, and drive all other birds from their vicinity. They will not permit even their young to keep in the same district, but drive them off when they are sufficiently able to shift for themselves. Martin, in his description of the Western Isles, avers, that there are three little islands among the number, which are occupied by a pair of ravens each, that drive off all other birds with great cries and impetuosity.

Notwithstanding the injury these birds do in picking out the eyes of sheep and lambs, when they find them sick and helpless, a vulgar respect is paid them, as being the birds that fed the prophet Elijah in the wilderness. This prepossession in favour of the raven is of very ancient date, as the Romans themselves, who thought the bird ominous, paid it, from

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cious than these birds, and on obtaining a morsel, rather than eat it at once, usually fly off with it to some more secure place.

The jackdaw is generally distributed in England and Scotland, although there are large tracts, the outer Hebrides for example, in which it does not occur. It is represented as inhabiting most parts of the continent, but has not been found in America.

Several species of the genus are very nearly allied to it, particularly Corvus bengalensis. Taking European birds only into consideration, it forms the transition to the magpie.—*Abridged from Macgillivray's History of British Birds.*

motives of fear, the most profound veneration.[1] One of these that had been kept in the temple of Castor, as Pliny informs us, flew down into the shop of a tailor, who took much delight in the visits of his new acquaintance. He taught the bird several tricks; but particularly to pronounce the names of the emperor Tiberius, and the whole royal family. The tailor was beginning to grow rich by those who came to see this wonderful raven, till an envious neighbour, displeased at the tailor's success, killed the bird, and deprived the tailor of his future hopes of fortune. The Romans, however, took the poor tailor's part; they punished the man who offered the injury, and gave the raven all the honours of a magnificent interment.

Birds in general live longer than quadrupeds; and the raven is said to be one of the most long-lived of the number. Hesiod asserts, that a raven will live nine times as long as a man; but though this is fabulous, it is certain that some of them have been known to live near a hundred years. This animal seems possessed of those qualities that generally produce longevity, a good appetite, and great exercise. In clear weather, the ravens fly in pairs to a great height, making a deep loud noise, different from that of their usual croaking.

The carrion-crow resembles the raven in its appetites, its laying, and manner of bringing up its young. It only differs in being less bold, less docile, and less favoured by mankind.

The rook leads the way in another, but a more harmless train, that have no carnivorous appetites, but only feed upon insects and corn. The Royston (or hooded) crow is about the size of the two former. The breast, belly, back, and upper part of the neck, being of a pale ash colour; the head and wings glossed over with a fine blue. He is a bird of passage, visiting this kingdom in the beginning of winter, and leaving it in the spring. He breeds, however, in different parts of the British dominions; and his nest is common enough in trees in Ireland. The jackdaw is black, like all the former, but ash-coloured on the breast and belly. He is not above the size of a pigeon. He is docile and loquacious. His head is large for the size of his body, which, as has been remarked, argues him ingenious and crafty. He builds in steeples, old castles, and high rocks, laying five or six eggs in a season. The Cornish chough is like a jackdaw, but bigger, and almost the size of a crow. The bill, feet, and legs, are long like those of a jackdaw, but of a red colour; and the plumage is black all over. It frequents rocks, old castles, and churches by the sea side, like the daw; and with the same noisy assiduity. It is only seen along the western coasts of England. These are birds very similar in their manners, feeding on grain and insects, living in society, and often suffering general castigation from the flock for the good of the community.

The rook, as is well known, builds in woods and forests in the neighbourhood of man, and sometimes makes choice of groves in the very midst of cities for the place of its retreat and security. In these it establishes a kind of legal constitution, by which all intruders are excluded from coming to live among them, and none suffered to build but acknowledged natives of the place. I have often amused myself with observing their plan of policy from my window in the Temple, that looks upon a grove where they have made a colony in the midst of the city. At the commencement of spring, the rookery, which during the continuance of winter seemed to have been deserted, or only guarded by about five or six, like old soldiers in a garrison, now begins to be once more frequented; and in a short time all the bustle and hurry of business is fairly commenced. Where these numbers resided during the winter is not easy to guess; perhaps in the trees of hedgerows, to be nearer their food. In spring, however, they cultivate their native trees; and, in the places where they were themselves hatched, they prepare to propagate a future progeny.[2]

[1] In several passages, Shakspeare alludes to the ominous character of the raven.

> "The raven himself is hoarse
> That croaks the fatal entrance of Duncan
> Under my battlements."
>
> *Macbeth*, Act i. Scene 5.

> "It comes o'er my memory,
> As doth the raven o'er the infected house,
> Boding to all."
>
> *Othello*, Act i. Scene 4.

See also *The Tempest*, Act i. Scene 2.

[2] Country people suppose that when rooks return from pasture making a more than usual noise with their wings, and with a quick flight, it is a sign of rain; and that, if part of them stay at the rookery, and sport about the trees, making their cawing note in a softer tone than usual, three or four times successively, it is a sign of fine weather.

Rooks appear to have a language amongst themselves, which is understood by the whole community; and a peculiar note from a bird set to watch and to warn them of approaching danger, is quite sufficient to make them take flight, and always in an opposite direction to that from which the danger is apprehended.

> "Their danger well the wary plunderers know,
> And place a watch on some conspicuous bough."

As the rook is a favourite, I am always sorry to see

They keep together in pairs; and when the offices of courtship are over, they prepare for making their nests and laying. The old inhabitants of the place are already provided; the nest which served them for years before, with a little trimming and dressing, will serve very well again; the difficulty of nestling lies only upon the young ones, who have

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it during a hard frost. Instead of being that active, happy bird which he appears to be in summer, strutting over a meadow, and either flirting with his mate, or feeding one of his young ones who has had strength enough to follow him, and who receives the food with fluttering wings and tremulous note, he is now, on the contrary, a moping, melancholy bird, appearing to avoid his old companions, and to be without sufficient energy even to seek for food, often remaining in one position for a considerable length of time.

There is one trait in the character of the rook which is, I believe, peculiar to that bird, and which does him no little credit,—it is the distress which is exhibited when one of them has been killed or wounded by a gun while they have been feeding in a field or flying over it. Instead of being scared away by the report of the gun, leaving their wounded or dead companion to his fate, they show the greatest anxiety and sympathy for him, uttering cries of distress, and plainly proving that they wish to render him assistance, by hovering over him, or sometimes making a dart from the air close up to him, apparently to try and find out the reason why he did not follow them,—

> "While circling round and round,
> They call their lifeless comrade from the ground."

If he is wounded, and can flutter along the ground, the rooks appear to animate him to make fresh exertions by incessant cries, flying a little distance before him, and calling to him to follow them. I have seen one of my labourers pick up a rook so wounded, which he had shot at for the purpose of putting him up as a scare-crow in a field of wheat, and while the poor wounded bird was still fluttering in his hand, I have observed one of his companions make a wheel round in the air, and suddenly dart past him so as almost to touch him, perhaps with a last hope that he might still afford assistance to his unfortunate mate or companion. Even when the dead bird has been hung, *in terrorem*, to a stake in the field, he has been visited by some of his former friends, but, as soon as they found that the case was hopeless, they have generally abandoned that field altogether.

When one considers the instinctive care with which rooks avoid any one carrying a gun, and which is so evident, that I have often heard country people remark that they can smell gunpowder, one can more justly estimate the force of their love or friendship in thus continuing to hover round a person, who has just destroyed one of their companions with an instrument, the dangerous nature of which they seem fully capable of appreciating.

That it is the instrument, and not the man, which they avoid, is evident from their following the heels of the peaceable ploughman along the furrow, sometimes taking short flights after him, and each rook showing some degree of eagerness to be nearest the ploughman, and to have the best chance of being the first to pick up the newly turned up worm, or the grub of the cockchafer, of which they are very fond.

Rooks are not easily induced to forsake the trees on which they have been bred, and which they frequently revisit after the breeding season is over. This is shown in Hampton Court Park, where there is an extensive rookery amongst the fine lime-trees, and where a barbarous and unnecessary custom prevails of shooting the young rooks. As many as a hundred dozen of them have been killed in one season, and yet the rooks build

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in the avenue, though there is a corresponding avenue close by, in Bushy Park, which they never frequent, notwithstanding the trees are equally high and equally secure. I never hear the guns go off during this annual slaughter without execrating the practice, and pitying the poor rooks, whose melancholy cries may be heard to a great distance, and some of whom may be seen, exhausted by their fruitless exertions, sitting melancholy on a solitary tree waiting till the *sport* is over, that they may return and see whether any of the offspring which they have reared with so much care and anxiety are left to them; or, what is more probable, the call for assistance of their young having ceased, they are aware of their fate, and are sitting in mournful contemplation of their loss. This may appear romantic, but it is nevertheless true: and whoever, like myself, has observed the habits and manners of the rook, and witnessed their attachment to each other and to their young,—and is convinced, as I am, that they have the power of communication by means of a language known to themselves, and are endowed with a knowledge and foresight most extraordinary, will take as much interest in them as I have confessed that I do.

Some farmers have a very mistaken notion that rooks are injurious to them. They certainly now and then feed on grain, but the damage they may do in this respect is much more than counterbalanced by the good they do in destroying the grubs of the cockchafer and beetles, and other insects which are injurious to the farmer.

Rooks are known to bury acorns, and I believe walnuts also, as I have observed them taking ripe walnuts from a tree and returning to it before they could have had time to break them and eat the contents. Indeed, when we consider how hard the shell of a walnut is, it is not easy to guess how the rook contrives to break them. May they not, by first burying them, soften the shells, and afterwards return to feed upon them?

The Reverend W. Bingley, an amiable naturalist, has observed, "that as soon as rooks have finished their nests, and before they lay, the cocks begin to feed the hens, who receive their bounty with a fondling, tremulous voice and fluttering wings, and all the little blandishments that are expressed by the young while in a helpless state, and that this gallant deportment of the male is continued through the whole season of incubation."

I must, however, add that my friends the rooks are somewhat given to thieving, and I am afraid that if both the birds left the nest at the same time, some of the other members of the community would soon deprive them of those sticks which they had collected with so much trouble. One of the birds is, therefore, always left to protect their property.

Rooks feed on various kinds of food, as well as worms. They are sad depredators on my cherry trees, attacking them early in the morning, and carrying off great quantities. They will also eat potatoes and pears, taking them away in their beaks. The grub of the cockchafer, however, seems to be their favourite food, and their search for it, especially in old mossy grass fields, may be seen by the little tufts of moss which are pulled up by them and scattered about. Their power of discovering this caterpillar by the scent is very extraordinary. A gentleman once showed me a field which had all the appearance of having been scorched, as if by a burning sun in dry hot weather. The turf peeled from the ground as if it had been cut with a turfing spade, and we then discovered that the roots of the grass had been

no nest, and must therefore get up one as well as they can. But not only the materials are wanting, but also the place in which to fix it. Every part of a tree will not do for this purpose, as some branches may not be sufficiently forked; others may not be sufficiently strong; and still others may be too much exposed to the rockings of the wind. The male and female upon this occasion are, for some days, seen examining all the trees of the grove very attentively; and when they have fixed upon a branch that seems fit for their purpose, they continue to sit upon and observe it very sedulously for two or three

eaten away by the larvæ of the cockchafer, which were found in countless numbers at various depths in the soil. This field was visited by a great quantity of rooks, though there was no rookery within many miles of the neighbourhood, who turned up and appeared to devour the grubs with great satisfaction.

Rooks are fond of company, the jackdaw and even the starling being allowed to associate with them, and a mutual good understanding seems to exist amongst them. Even the sparrow is sometimes allowed to build its nest under the protection of that of a rook.

Wilson, in his American Ornithology, says that crows have been employed to catch crows by the following stratagem:—A live crow is pinned by the wings down to the ground on his back, by means of two sharp forked sticks. Thus situated, his cries are loud and incessant, particularly if any other crows are within view. These sweeping down about him, are instantly grappled and held fast by the prostrate prisoner, with the same instinctive impulse that urges a drowning person to grasp at every thing within his reach. The game being disengaged from his clutches, the trap is again ready for another experiment; and by pinning down each captive successively, as soon as taken, in a short time you will probably have a large flock screaming above you, in concert with the outrageous prisoners below.*

The same author mentions an agreeable instance of attachment in a crow. "A gentleman, who resided on the Delaware, a few miles below Easton, had raised (reared) a crow, with whose tricks and society he used frequently to amuse himself. This crow lived long in the family, but at length disappeared, having, as was then supposed, been shot by some vagrant gunner, or destroyed by accident. About eleven months after this, as the gentleman, one morning, in company with several others, was standing on the river shore, a number of crows happening to pass by, one of them left the flock, and flying directly towards the company, alighted on the gentleman's shoulder, and began to gabble away with great volubility, as one long absent friend naturally enough does on meeting with another. Recovering from his surprise, the gentleman instantly recognised his old acquaintance, and endeavoured, by several civil, but sly manœuvres, to lay hold of him: but the crow, not altogether relishing quite so much familiarity, having now had a taste of the sweets of liberty, cautiously eluded all his attempts; and suddenly glancing his eye on his distant companions, mounted in the air after them, soon overtook and mingled with them, and was never afterwards seen to return."

The rook seems to be even more unpopular in America than he is in this country. Mr Wilson says, that he is there branded as a thief and a plunderer; a kind of black-coated vagabond, who hovers over the fields of the industrious, fattening on their labours, and, by his voracity, often blasting their expectations. Hated as he is by the farmer, watched and persecuted by almost every bearer of a gun, who all triumph in his destruction, had not heaven bestowed on him intelligence and sagacity, far beyond what is common in other birds, there is reason to believe that the whole tribe would long ago have ceased to exist.

* This method of catching crows is, I believe, practised in some parts of England to catch jays, who make a most violent outcry when pinned to the ground.

The average number of rooks' nests, during the last four years, in the avenue of Hampton Court Park, has been about 750. Allowing three young birds and a pair of old ones to each nest, the number would amount to 3750. They are very particular that none of their society build away from the usual line of trees. A pair of rooks did so this spring, and when their nest was nearly finished, at least fifty others came and demolished it in a few minutes. Rooks may be seen teaching their young to fly as soon as they leave the nest, advancing a little way before, and calling upon them to follow. These short flights are incessantly repeated, till the young ones have acquired sufficient strength and skill to follow the old birds.

Rooks sometimes choose odd places to build in, and where we should have hardly expected to find the nest of a bird of such social habits. Dr Mitchell says that a few years ago a pair of rooks built their nest between the wings of the dragon of Bow Church in London. They remained there till the steeple required repairs. He adds, that the same or another pair have this spring built their nest on the top of a large plane tree in Wood Street, close to Cheapside. Last season a hawk built its nest under the dome of St Paul's, and a similar occurrence took place about forty years ago. Another of the falcon tribe had its nest, a few years ago, in the top of the steeple of Spitalfields Church.

Colonel Montague mentions an instance of great sagacity in crows. He observed two of them by the sea-shore, busy in removing small fish beyond the flux of the flowing tide, and depositing them just above high-water mark, under the broken rocks, after having satisfied the calls of hunger.

Mr Hone, in his "Every Day Book," has introduced an agreeable anecdote respecting a rookery on some high trees behind the Ecclesiastical Court, in Doctor's Commons. "Some years ago there were several large elm trees in the college garden behind the Ecclesiastical Court, in Doctor's Commons, in which a number of rooks had taken up their abode, forming, in appearance, a sort of *convocation* of aerial ecclesiastics. A young gentleman, who lodged in an attic, and was their close neighbour, frequently entertained himself with thinning this covey of black game, by means of a cross-bow. On the opposite side lived a curious old civilian, who observing from his study that the rooks often dropped senseless from their perch, or, as it may be said, without using a figure, *hopp'd the twig*, making no sign, nor any sign being made to his vision to account for the phenomenon, set his wits to work to discover the cause. It was probably during a profitless time of peace, and the doctor having plenty of leisure, weighed the matter over and over, till he was at length fully satisfied that he had made a great ornithological discovery, that its promulgation would give wings to his fame, and that he was fated by means of these rooks to say—

Volito vivus per ora virum.

His goose-quill and foolscap were quickly in requisition, and he actually wrote a treatise, stating circumstantially what he himself had seen, and in conclusion, giving it as the settled conviction of his mind, that rooks were subject to the *falling sickness!*"—*Jesse's Gleanings, Vol. I.*

days longer. The place being thus determined upon, they begin to gather the materials for their nest; such as sticks and fibrous roots, which they regularly dispose in the most substantial manner. But here a new and unexpected obstacle arises. It often happens that the young couple have made choice of a place too near the mansion of an older pair, who do not choose to be incommoded by such troublesome neighbours. A quarrel therefore instantly ensues, in which the old ones are always victorious.

The young couple, thus expelled, are obliged again to go through the fatigues of deliberating, examining and choosing; and having taken care to keep their due distance, the nest begins again, and their industry deserves commendation. But their alacrity is often too great in the beginning; they soon grow weary of bringing the materials of their nest from distant places; and they very easily perceive that sticks may be provided nearer home, with less honesty, indeed, but some degree of address. Away they go, therefore, to pilfer, as fast as they can; and whenever they see a nest unguarded, they take care to rob it of the very choicest sticks of which it is composed. But these thefts never go unpunished; and probably upon complaint being made there is a general punishment inflicted. I have seen eight or ten rooks come upon such occasions, and, setting upon the new nest of the young couple all at once, tear it in pieces in a moment.

At length, therefore, the young pair find the necessity of going more regularly and honestly to work. While one flies to fetch the materials, the other sits upon the tree to guard it; and thus in the space of three or four days, with a skirmish now and then between, the pair have fitted up a commodious nest, composed of sticks without, and of fibrous roots and long grass within. From the instant the female begins to lay, all hostilities are at an end; not one of the whole grove, that a little before treated her so rudely, will now venture to molest her; so that she brings forth her brood with patient tranquillity. Such is the severity with which even native rooks are treated by each other; but if a foreign rook should attempt to make himself a denizen of their society, he would meet with no favour; the whole grove would at once be up in arms against him, and expel him without mercy.

In some countries these birds are considered as a benefit, in others as a nuisance: their chief food is the worm of the door-beetle, and corn; thus they may be said to do as much service by destroying that noxious insect, as they do injury by consuming the produce of the husbandman's industry.

To this tribe of the crow-kind, some foreign sorts might be added: I will take notice only of one, which, from the extraordinary size and fashion of its bill, must not be passed in silence.[1] This is the Calao, or horned Indian raven, which exceeds the common raven in size, and habits of depredation. But what he differs in from all other birds is the beak, which by its length and curvature at the end, appears designed for rapine; but then it has a kind of horn standing out from the top, which looks somewhat like a second bill, and gives this bird, otherwise fierce and ugly, a very formidable appearance. The horn springs out of the forehead, and grows to the upper part of the bill, being of great bulk; so that near the forehead it is four inches broad, not unlike the horn of a rhinoceros, but more crooked at the tip. Were the body of the bird answerable in size to the head, the calao would exceed in magnitude even the vulture or the eagle. But the head and beak are out of all proportion, the body being not much larger than that of a hen. Yet even here there are varieties; for in such of those birds as come from different parts of Africa, the body is proportionable to the beak; in such as come from the Molucca islands, the beak bears no proportion to the body. Of what use this extraordinary excrescence is to the bird, is not easy to determine; it lives, like others of its kind, upon carrion, and seldom has a living enemy to cope with. Nature seems to sport in the production of many animals, as if she were willing to exhibit instances as well of variety as economy in their formation.

CHAP. III.

OF THE MAGPIE, AND ITS AFFINITIES.

There are such a variety of birds that may be distributed under this head, that we must not expect very precise ideas of any. To have a straight strong bill, legs formed for hopping, a body of about the size of a magpie, and party-coloured plumage, are the only marks by which I must be contented to distinguish this numerous fantastic tribe, that add to the beauty, though not to the harmony, of our landscapes. In fact, their chattering every where disturbs the melody of the lesser warblers; and their noisy courtship not a little damps the song of the linnet and the nightingale.

However, we have very few of this kind in our woods compared to those in the neighbour-

[1] There are also the *Fish Crow*, which lives on dead fish and other garbage by the river and sea shore, and *Clark's Crow*, which resembles somewhat the jackdaw, both described by Wilson in his Ornithology.

hood of the line. There they not only paint the scene with the beauty and the variety of their plumage, but stun the ear with their vociferation. In those luxurious forests, the singing-birds are scarcely ever heard, but a hundred varieties of the pie, the jay, the roller, the chatterer, and the toucan, are continually in motion, and with their illusive mockeries disturb or divert the spectator, as he happens to be disposed.

The Magpie is the chief of this kind with us, and is too well known to need a description.



Indeed, were its other accomplishments equal to its beauty, few birds could be put in competition. Its black, its white, its green, and purple, with the rich and gilded combination of the glosses on its tail, are as fine as any that adorn the most beautiful of the feathered tribe. But it has too many of the qualities of a beau to depreciate these natural perfections: vain, restless, loud, and quarrelsome, it is an unwelcome intruder every where; and never misses an opportunity, when it finds one, of doing mischief.

The magpie bears a great resemblance to the butcher-bird in its bill, which has a sharp process near the end of the upper chap, as well as in the shortness of its wings, and the form of the tail; each feather shortening from the two middlemost. But it agrees still more in its food, living not only upon worms and insects, but also upon small birds when they can be seized. A wounded lark, or a young chicken separated from the hen, are sure plunder; and the magpie will even sometimes set upon and strike a blackbird.

The same insolence prompts it to tease the largest animals, when its insults can be offered with security. They often are seen perched upon the back of an ox or a sheep, pecking up the insects to be found there, chattering, and tormenting the poor animal at the same time, and stretching out their necks for combat, if the beast turns its head backward to reprehend him. They seek out also the nests of birds: and, if the parent escapes, the eggs make up for the deficiency: the thrush and the blackbird are but too frequently robbed by this assassin, and this, in some measure, causes their scarcity.

No food seems to come amiss to this bird; it shares with ravens in their carrion, with rooks in their grain, and with the cuckoo in birds' eggs: but it seems possessed of a providence seldom usual with gluttons; for when it is satisfied for the present, it lays up the remainder of the feast for another occasion. It will even in a tame state hide its food when it has done eating, and after a time return to the secret hoard with renewed appetite and vociferation.

In all its habits it discovers a degree of instinct unusual to other birds. Its nest is not less remarkable for the manner in which it is composed, than for the place the magpie takes to build it in. The nest is usually placed conspicuous enough, either in the middle of some hawthorn-bush, or on the top of some high tree. The place, however, is always found difficult of access; for the tree pitched upon usually grows in some thick hedge-row fenced by brambles at the root; or sometimes one of the higher bushes is fixed upon for the purpose. When the place is thus chosen as inaccessible as possible to men, the next care is to fence the nest above so as to defend it from all the various enemies of air. The kite, the crow, and the sparrow-hawk, are to be guarded against; as their nests have been sometimes plundered by the magpie, so it is reasonably feared that they will take the first opportunity to retaliate. To prevent this, the magpie's nest is built with surprising labour and ingenuity.

The body of the nest is composed of hawthorn branches, the thorns sticking outward, but well united together by their mutual insertions. Within it is lined with fibrous roots, wool, and long grass, and then nicely plastered all round with mud and clay. The body of the nest being thus made firm and commodious, the next work is to make the canopy which is to defend it above. This is composed of the sharpest thorns, wove together in such a manner as to deny all entrance except at the door, which is just large enough to permit egress and regress to the owners. In this fortress the male and female hatch and bring up their brood with security, sheltered from all attacks but those of the climbing school-boy, who often finds his torn and bloody hands too dear a price for the eggs or the young ones. The magpie lays six or seven eggs, of a pale green colour, spotted with brown.

This bird, in its domestic state, preserves its natural character with strict propriety. The same noisy mischievous habits attend it to the cage that marked it in the woods; and being more cunning, so it is also a more docile bird than any other taken into keeping. Those who are desirous of teaching it to speak have a foolish custom of cutting its tongue,

which only puts the poor animal to pain, without improving its speech in the smallest degree. Its speaking is sometimes very distinct; but its sounds are too thin and sharp to be an exact imitation of the human voice, which the hoarse raven and parrot can counterfeit more exactly.

To this tribe we may refer the jay, which is one of the most beautiful of the British birds. The forehead is white, streaked with



black; the head is covered with very long feathers, which it can erect into a crest at pleasure; the whole neck, back, breast, and belly, are of a faint purple, dashed with gray; the wings are most beautifully barred with a lovely blue, black, and white; the tail is black, and the feet of a pale brown. Like the magpie, it feeds upon fruits, will kill small birds, and is extremely docile.[1]

[1] The *Jays* differ from the pies principally in the bill, which is more hooked, and in having some long loose feathers on the crown of the head, which are erected when the birds are excited; the tail, moreover, in these birds, is longer and more graduated. They may almost be said to be omnivorous, living in general in the woods, but occasionally resorting to gardens and cultivated lands, to both of which they are injurious and destructive, as well by what they eat at the time, as by what they carry off to increase their hidden stores. In summer they live in pairs, but in the opposite season assemble in small groups. They advance on the ground always by leaps, and seldom or never walk. In disposition they are very irascible, petulant, and inquisitive, and take their scientific generic name, *garrulus*, from their constant loquacity. The nest is built in trees, generally at about half-way from the bottom, of sticks, interlaced together on the outside, cased within with mud, and lined with dry grass and fibres: the entrance to it is at the side. The eggs are white, spotted with brown and gray, and are from six to eight in number.

The common jay does not seem to be very generally or exclusively located, and is partially migratory from the west and northern parts of Europe to the south-east, as the islands of the Grecian Archipelago, and also Egypt, Syria, &c. Though many are thus said to migrate, it is nevertheless clear that some continue in our own country and in France the whole year.

The *Red-Billed Jay* is a very splendid bird. The bill and feet are red; the neck and breast are black; the crown of the head dotted black and white; body, above and beneath, ashen; of the tail feathers, the two intermediate are much the longest, and the lateral feathers are graduated; they are blue, tipt with white, and a black bar between that colour and the blue. Inhabits China, and is frequently rendered very tame and amusing. Of

The Chatterer also, which is a native of Germany, may be placed in this rank; and is somewhat less than the former. It is variegated with a beautiful mixture of colours; red,

the *Blue Jay*, an inhabitant of North America, (See Plate XV. fig. 8.) Wilson has given the following interesting account.

"The blue jay is an almost universal inhabitant of the woods, frequenting the thickest settlements as well as the deepest recesses of the forest, where his squalling voice often alarms the deer, to the disappointment and mortification of the hunter,—one of whom informed me that he made it a point, in summer, to kill every jay he could meet with. In the charming season of spring, when every thicket pours forth harmony, the part performed by the jay always catches the ear. He appears to be among his fellow musicians what the trumpeter is in a band, some of his notes having no distant resemblance to the tones of that instrument. These he has the faculty of changing through a great variety of modulations, according to the particular humour he happens to be in. When disposed for ridicule, there is scarce a bird whose peculiarities of song he cannot tune his notes to. When engaged in the blandishments of love, they resemble the soft chatterings of a duck, and, while he nestles among the thick branches of the cedar, are scarce heard at a few paces distance: but he no sooner discovers your approach than he sets up a vehement outcry, flying off, and screaming with all his might, as if he called the whole feathered tribe of the neighbourhood to witness some outrageous usage he had received. When he hops undisturbed among the high branches of the oak and hickory, they become soft and musical; and his calls for the female a stranger would mistake for the repeated screakings of an ungreased wheel-barrow. All these he accompanies with various nods, and jerks, and other gesticulations, for which the whole tribe of jays are so remarkable, that, with some other peculiarities, they might have very well justified the great Swedish naturalist in forming them into a separate genus by themselves.

"The blue jay builds a large nest, frequently in the cedar, sometimes on an apple-tree, lines it with dry fibrous roots, and lays five eggs, of a dull olive, spotted with brown. The male is particularly careful of not being heard near the place, making his visits as silently and secretly as possible. His favourite food is chestnuts, acorns, and Indian corn. He occasionally feeds on bugs and caterpillars, and sometimes pays a plundering visit to the orchard, cherry rows, and potato patch; and has been known, in times of scarcity, to venture into the barn, through openings between the weather boards. In these cases he is extremely active and silent, and, if surprised in the act, makes his escape with precipitation, but without noise, as if conscious of his criminality.

"Of all birds he is the most bitter enemy to the owl. No sooner has he discovered the retreat of one of these, than he summons the whole feathered fraternity to his assistance, who surround the glimmering *solitaire*, and attack him from all sides, raising such a shout as may be heard, in a still day, more than half a mile off. When, in my hunting excursions, I have passed near this scene of tumult, I have imagined to myself that I heard the insulting party venting their respective charges with all the virulence of a Billingsgate mob; the owl, meanwhile, returning every compliment with a broad oggling stare. The war becomes louder and louder, and the owl at length, forced to betake himself to flight, is followed by his whole train of persecutors, until driven beyond the boundaries of their jurisdiction.

"But the blue jay himself is not guiltless of similar depredations with the owl, and becomes in his turn the

ash-colour, chestnut, and yellow; but what distinguishes it from all other birds, are the horny appendages from the tips of seven of the lesser quill feathers, which stand bare of beards, and have the colour and gloss of the best red sealing wax.

The Roller is not less beautiful than any of the former. (For Noisy Roller, see Plate XV. fig. 11; for Green Roller, see Plate XVII. fig. 5.) The breast and belly are blue; the head green; and the wings variegated with blue, black, and white. But it may be distinguished from all others by a sort of naked tubercles or warts near the eyes, which still farther contribute to increase its beauty.

To this class may be added a numerous list from all the tropical forests of the east and west; where the birds are remarkable for discordant voices and brilliant plumage. I will fix only upon one, which is the most singular of all the feathered creation. This is the Toucan, a bird of the pie kind, whose bill



is nearly as large as the rest of its whole body.[1]

Of this extraordinary bird there are four or five varieties. I will only describe the red-beaked toucan; and as the figure of this bird makes the principal part of its history, I

very tyrant he detested, when he sneaks through the woods, as he frequently does, and among the thickets and hedge-rows, plundering every nest he can find of its eggs, tearing up the callow young by piecemeal, and spreading alarm and sorrow around him. The cries of the distressed parents soon bring together a number of interested spectators (for birds in such circumstances seem truly to sympathise with each other,) and he is sometimes attacked with such spirit as to be under the necessity of making a speedy retreat.

"He will sometimes assault small birds, with the intention of killing and devouring them; an instance of which I myself once witnessed, over a piece of woods near the borders of Schuylkill; where I saw him engaged for more then five minutes pursuing what I took to be a species of motacilla (*m. maculosa*, yellow rump,) wheeling, darting, and doubling in the air, and, at last, to my great satisfaction, got disappointed in the escape of his intended prey. In times of great extremity, when his hoard or magazine is frozen up, buried in snow, or perhaps exhausted, he becomes very voracious, and will make a meal of whatever carrion or other animal substance comes in the way, and has been found regaling himself on the bowels of a robin (*turdus migratorius*) in less than five minutes after it was shot.

"There are, however, individual exceptions to this general character for plunder and outrage, a proneness for which is probably often occasioned by the wants and irritations of necessity. A blue jay, which I have kept for some time, and with which I am on terms of familiarity, is in reality a very notable example of mildness of disposition and sociability of manners. An accident in the woods first put me in possession of this bird, while in full plumage, and in high health and spirits; I carried him home with me, and put him into a cage already occupied by a golden-winged woodpecker (*picus auratus*,) where he was saluted with such rudeness, and received such a drubbing from the lord of the manor, for entering his premises, that, to save his life, I was obliged to take him out again. I then put him into another cage, where the only tenant was a female *oriolus spurius* (bastard baltimore.) She also put on airs of alarm, as if she considered herself endangered and insulted by the intrusion; the jay, meanwhile, sat mute and motionless on the bottom of the cage, either dubious of his own situation, or willing to allow time for the fears of his neighbour to subside. Accordingly, in a few minutes, after displaying various threatening gestures (like some of those Indians we read of in their first interviews with the whites,) she began to make her approaches, but with great circumspection, and readiness for retreat. Seeing, however, the jay begin to pick up some crumbs of broken chestnuts, in an humble and peaceable way, she also descended, and began to do the same; but, at the slightest motion of her new guest, wheeled round and put herself on the defensive. All this ceremonious jealousy vanished before evening; and they now roost together, feed, and play together, in perfect harmony and good humour. When the jay goes to drink, his mess-mate very impudently jumps into the saucer to wash herself, throwing the water in showers over her companion, who bears it all patiently; venturing now and then to take a sip between every splash, without betraying the smallest token of irritation. On the contrary, he seems to take pleasure in his little fellow-prisoner, allowing her to pick (which she does very gently) about his whiskers, and to clean his claws from the minute fragments of chestnuts which happen to adhere to them. This attachment on the one part, and mild condescension on the other, may, perhaps, be partly the effect of mutual misfortunes, which are found not only to knit mankind, but many species of inferior animals, more closely together: and shows that the disposition of the blue jay may be humanized, and rendered susceptible of affectionate impressions, even for those birds which, in a state of nature, he would have no hesitation in making a meal of.

"He is not only bold and vociferous, but possesses a considerable talent for mimicry, and seems to enjoy great satisfaction in mocking and teasing other birds, particularly the little hawk (*f. Sparverius*,) imitating his cry wherever he sees him, and squealing out as if caught: this soon brings a number of his own tribe around him, who all join in the frolic, darting about the hawk, and feigning the cries of a bird sorely wounded, and already under the clutches of its devourer; while others lie concealed in bushes, ready to second their associates in the attack. But this ludicrous farce often terminates tragically. The hawk, singling out one of the most insolent and provoking, sweeps upon him in the unguarded moment, and offers him up a sacrifice to his hunger and resentment. In an instant the tune is changed; all their buffoonery vanishes, and loud and incessant screams proclaim their disaster."

[1] The enormous beak is nearly as long as the body; and this circumstance has given rise to the belief that the toucan is greatly embarrassed by this extraordinary provision of nature, and rendered incapable of those active movements which so peculiarly distinguish the feathered race. If the beak, indeed, were constructed in that solid manner which we ordinarily observe in birds of prey, and in those who live upon hard substances, we should not be surprised to find so considerable an appendage weighing

will follow Edwards through all the minutiæ of its singular conformation. It is about the size of, and shaped like, a jackdaw, with a large head to support its monstrous bill; this bill, from the angles of the mouth to its point, is six inches and a half; and its breadth, in the thickest part, is a little more than two. Its thickness near the head, is one inch and a quarter; and it is a little rounded along the top of the upper chap, the under side being round also; the whole of the bill is extremely slight, and a little thicker than parchment. The upper chap is of a bright yellow, except on each side, which is of a fine scarlet colour; as is also the lower chap, except at the base, which is purple. Between the head and the bill there is a black line of separation all round the base of the bill; in the upper part of which the nostrils are placed, and are almost covered with feathers; which has occasioned some writers to say, that the toucan has no nostrils. Round the eyes, on each side of the head, is a space of bluish skin, void of feathers, above which the head is black, except a white spot on each side joining to the base of the upper chap. The hinder part of the neck, the back, wings, tail, belly, and thighs, are black. The under side of the head, throat, and the beginning of the breast, are white. Between the white on the breast, and the black on the belly, is a space of red feathers, in the form of a new moon, with its horns upwards. The legs, feet, and claws, are of an ash-colour; and the toes stand like those of the parrot, two before, and two behind.

It is reported, by travellers, that this bird, though furnished with so formidable a beak, is harmless and gentle, being so easily made tame, as to sit and hatch its young in houses. It feeds chiefly upon pepper, which it devours very greedily, gorging itself in such a manner that it voids it crude and unconcocted. This, however, is no objection to the natives from using it again; they even prefer it before that pepper which is fresh gathered from the tree: and seem persuaded that the strength and heat of the pepper is qualified by the bird, and that all its noxious qualities are thus exhausted.

Whatever be the truth of this report, nothing is more certain than that the toucan lives only upon a vegetable diet; and in a domestic state, to which it is frequently brought in the warm countries where it is bred, it is seen to prefer such food to all other. Pozzo, who bred one tame, asserts, that it leaped up and down, wagged the tail, and cried with a voice resembling that of a magpie. It fed upon the same things that parrots do; but was most greedy of grapes, which, being plucked off one by one, and thrown into the air, it would most dexterously catch before they fell to the ground. Its bill, he adds, was hollow, and upon that account very light, so that it had but little strength in so apparently formidable a weapon; nor could it peck or strike smartly therewith. But its tongue seemed to assist the efforts of this unwieldy machine; it was long, thin, and flat, not unlike one of the feathers on the neck of a dunghill-cock; this it moved up and down, and often extended five or six inches from the bill. It was of a flesh colour, and very remarkably fringed on each side with very small filaments, exactly resembling a feather.

It is probable that this long tongue has greater strength than the thin hollow beak

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down the unfortunate bird's head, and unfitting it for upward flight, or even for ordinary vision, excepting in one direction. In that case the toucan must have been doomed to a grovelling life upon the earth, perpetually striving to use its brilliant wings, and longing to search for food amongst the high branches of fruit-bearing trees,—but striving and longing in vain. This would not have been in conformity with the usual harmony of nature; and, therefore, in spite of its enormous beak, we find the toucans flying as nimbly as any other bird from tree to tree—perching on the summits of the very highest—searching for fruit with restless activity—pursuing small birds which, it is now ascertained, form part of their food—and defending their young with unremitting vigilance against serpents, monkeys, and other enemies. All these functions of their existence could not have been performed if the specific gravity of the beak were equal to its dimensions. But it is not so. As compared, in specific gravity, with the beak of a hawk, for instance, the beak of the toucan may be said to stand in the same relation to it as a piece of pumice-stone to a piece of granite. The exterior of the beak is a spongy tissue, presenting a number of cavities, formed by extremely thin plates, and covered with a hard coat scarcely thicker. This remarkable beak forms almost as curious and wonderful an example of peculiar organization as the trunk of the elephant. We are not so intimately acquainted with its uses; but there can be no doubt that the instrument is admirably adapted to the necessities of the toucan's existence.

The toucans, as well as the aracaris, (for aracari toucan, see Plate XVII. fig. 15.) which they greatly resemble, are found in the warmest parts of South America. Their plumage is brilliant; and their feathers have been employed as ornaments of dress by the ladies of Brazil and Peru. Several specimens have been kept alive in this country. Mr Broderip, in the Zoological Journal for January 1825, has given an interesting account of a specimen in a small menagerie, whose habits he watched with great care. By this examination the fact was established that the toucan ordinarily feeds on small birds. The toucan in question, upon a goldfinch being put into his cage, would instantly kill it by a squeeze of his bill, and then deliberately pull his prey to pieces, swallowing every portion, not excepting the beak and the legs. Mr Broderip states that the toucan appeared to derive the greatest satisfaction from the act of eating, which he ascribes to the peculiar sensibility of the internal part of the beak. He never used his foot except to confine his prey on the perch: the beak was the only instrument employed in tearing it to pieces. It appears, also, that this bird subjects some of its food to a second mastication by its beak, in a manner somewhat resembling the similar action in ruminating animals.

that contains it. It is likely that the beak is only a kind of sheath for this peculiar instrument, used by the toucan, not only in making itself a nest, but also in obtaining its provision. Nothing is more certain, than that this bird builds its nest in holes of trees, which have been previously scooped out for this purpose; and it is not very likely that so feeble a bill could be very serviceable in working upon such hard materials.

Be this as it will, there is no bird secures its young better from external injury than the toucan. It has not only birds, men, and serpents, to guard against, but a numerous tribe of monkeys, still more prying, mischievous, and hungry, than all the rest. The toucan, however, scoops out its nest in the hollow of some trees, leaving only a hole large enough to go in and out at. There it sits, with its great beak, guarding the entrance, and if the monkey venture to offer a visit of curiosity, the toucan gives him such a welcome, that he presently thinks proper to pack off, and is glad to escape with safety.

This bird is only found in the warm climates of South America, where it is in great request, both for the delicacy of its flesh, which is tender and nourishing, and for the beauty of its plumage, particularly the feathers of the breast. The skin of this part the Indians pluck off, and, when dry, glue to their cheeks; and this they consider as an irresistible addition to their beauty.[1]

[1] The Rhinoceros Bird is of the order *Picæ* or Pies, and of the genus, *Buceros*, consisting of birds of rather large size, and distinguished by the disproportionate forms of their beaks, which are often still further remarkable for some kind of large prominence on the upper mandible. The most conspicuous species is the *Buceros Rhinoceros* of Linnæus, commonly called the rhinoceros bird.

Its general size is that of a turkey, but with a much more slenderly proportioned body. Its colour is black, with the tail white, crossed by a black bar: the beak is of enormous size, of a lengthened, slightly curved, and pointed shape, and on the upper mandible, towards the base, is an extremely large process, equal in thickness to the bill itself, and turning upwards and backwards in the form of a thick, sharp-pointed horn, somewhat resembling the horn of the rhinoceros. The use of this strange proboscis is by some supposed to be that of enabling the bird more easily to tear out the entrails of its prey; but others affirm that it is not of a predaceous nature, feeding only on vegetable substances. This bird is principally found in the East Indian Islands.

The *Trogons* constitute a family of birds, the members of which are peculiar to the hotter regions of America, and of India, and its adjacent islands, Ceylon, Java, Sumatra, &c., one species only having as yet been discovered in Africa. Among the most conspicuous of the feathered tribes for beauty and brilliancy of plumage, the trogons stand confessedly pre-eminent. The metallic golden green of some species is of dazzling effulgence; in others less gorgeous: the delicate pencillings of the plumage, and the contrasted hues of deep scarlet, black, green, and brown, produce a rich and beautiful effect. Nor is their shape and contour unworthy of their dress; were they far less elegantly arrayed they would still be pleasing birds.

The trogons are *zygodactyle*, that is, they have their toes in pairs, two before and two behind, like parrots and woodpeckers; the *tarsi* are short and feeble, the beak is stout, and the gape wide; the general contour of the body is full and round, and the head large; the plumage is dense, soft, and deep; the wings are short but pointed, the quill feathers being rigid; the tail is long, ample, and graduated, its outer feathers decreasing in length; in some species, and especially in that brilliant bird the resplendent trogon (*trogon resplendens*, Gould,) the tail-coverts are greatly elongated, so as to form a beautiful pendent plumage of loose wavy feathers.

Of solitary habits, the trogons (or *coroucui*) frequent the most secluded portions of dense forests, remote from the abodes of man. For hours together they sit motionless on some branch, uttering occasionally a plaintive melancholy cry, especially while the female is brooding on her eggs. Indifferent during the day to every object, listless or slumbering on their perch, they take no notice of the presence of an intruder, and may indeed be often so closely approached as to be knocked down by a stick; the bright glare of the sun obscures their sight, and they wait for evening, the dusk of twilight being their season of activity.

Fruits, insects and their larvæ, constitute their food. Formed, most of them at least, for rapid but not protracted flight, they watch from their perch the insects flitting by, and dart after them with surprising velocity, returning after their short chase to the same point of observation. Some, however, are almost exclusively frugivorous; we allude more especially to those whose flowing plumes impede the freedom of their flight; such seek for fruits and berries. Many species are certainly migratory. M. Natterer observes, respecting the pavonine trogon, which, in great numbers, inhabits, during a certain season of the year, the high woods along the upper part of the Amazon and Rio Negro, that he found the contents of its stomach to consist principally of the fruit of a certain species of palm, and that it arrives in those districts when its favourite food is ripe, but that when the trees no longer yield an adequate supply, it retires to other districts.

Like the parrots and woodpeckers, the trogons breed in the hollows of decayed trees, the eggs being deposited on a bed of wood-dust, the work of insects; they are three or four in number, and white. The young, when first hatched, are totally destitute of feathers, which do not begin to make their appearance for two or three days; and their head and beak appear to be disproportionately large. They are said to rear two broods in the year.

The American trogons have their beak of moderate size, with serrated (or saw-like) edges, and furnished at its base with bristles; the upper surface (of the males at least) is of a rich metallic green, the under parts being more or less universally scarlet or rich yellow. The outer tail-feathers in the majority of the species are more or less barred with black and white.

In the Indian trogons the beak is larger and stouter, with smooth edges, having a tooth near the tip of the upper mandible. The eyes are encircled by a large bare space of richly-coloured skin; the upper surface

CHAP. IV.

OF THE WOODPECKER, AND ITS AFFINITIES.

We now come to the numerous tribe of Woodpeckers: a class easily distinguished

from all others, both for their peculiar formation, their method of procuring food, and their manner of providing a place of safety for their young. Indeed, no other class of birds seems more immediately formed for the method of life they pursue, being fitted by nature, at all points, for the peculiarity of their condition. They live chiefly upon the insects contained in the body of trees; and for this purpose are furnished with a straight, hard, strong, angular, and sharp bill, made for piercing and boring. They have a tongue of a very great length; round, ending in a sharp, stiff, bony thorn, dentated on each side, to strike ants and insects when dislodged from their cells. Their legs are short and strong, for the purposes of climbing. Their toes stand two forward, and two backward; which is particularly serviceable in holding by the branches of the trees. They have hard stiff tails to lean upon when climbing. They feed only upon insects, and want that intestine which anatomists call the *cæcum;* a circumstance peculiar to this tribe only.

Of this bird there are many kinds, and many varieties in each kind. They form large colonies in the forests of every part of the world. They differ in size, colour, and appearance; and agree only in the marks above mentioned, or in those habits which result from so peculiar a conformation. Instead, therefore, of descending into a minute discrimination of every species, let us take one for a pattern, to which all the rest will be found to bear the strongest affinity. Words can but feebly describe the plumage of a bird; but it is the province of history to enter into a detail of every animal's pursuits and occupations.

The Green Woodspite, or Woodpecker, is called the *rainfowl* in some parts of the country; because, when it makes a greater noise than ordinary, it is supposed to foretell rain. It is about the size of a jay; the throat, breast, and belly, are of a pale greenish colour; and the back, neck, and covert feathers of the wings, are green. But the tongue of this little animal makes its most distinguished characteristic, as it serves for its support and defence. As was said above, the woodpecker feeds upon insects; and particularly on those which are lodged in the body of hollow or of rotting trees. The tongue is its instrument for killing and procuring this food; which cannot be found in great plenty. This is round, ending in a stiff, sharp, bony tip, dentated on both sides, like the beard of an arrow, and this it can dart out three or four inches from the bill, and draw in again at pleasure. Its prey is thus transfixed, and drawn into the bill, which, when swallowed, the dart is again launched at fresh game. Nothing has employed the attention of the curious in this part of anatomy, more than the contrivance by which the tongue of this bird performs its functions with such great celerity. The tongue is drawn back into the bill by the help of two small round cartilages, fastened into the forementioned bony tip, and running along the length of the tongue. These cartilages, from the root of the tongue, take a circuit beyond the ears; and being reflected backwards to the crown of the head, make a large bow. The muscular spongy flesh of the tongue incloses these cartilages, like a sheath; and is so made that it may be extended or contracted like a worm. The cartilages indeed have muscles accompanying them along their whole length backwards.—But there is still another contrivance; for there is a broad muscle joining the cartilages to the bones of the skull, which, by contracting or dilating, forces the cartilages forward through the tongue, and then forces the tongue and all through the bill, to be employed for the animal's preservation in piercing its prey.

Such is the instrument with which this bird is provided; and this the manner in which this instrument is employed. When a woodpecker, by its natural sagacity, finds out a rotten hollow tree, where there are worms, ant's eggs, or insects, it immediately prepares for its operations. Resting by its strong claws, and leaning on the thick feathers of its tail, it begins to bore with its sharp strong beak, until it discloses the whole internal habitation. Upon this, either through pleasure at the sight of its prey, or with a desire to alarm the insect colony, it sends forth a loud

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is brown, the lower more or less scarlet, and the outer tail-feathers exhibit no tendency towards a barred style of marking, excepting in one species, Diard's trogon, in which the three outer tail-feathers are finely powdered with black.

The African species (*trogon narina*, Levaill.) closely approximates to its American relatives; but its three outer tail-feathers are unbarred. This species inhabits the dense forests of Caffraria; during the day it sits motionless on a low dead branch, and it is only in the morning and evening that it displays activity. Locusts and other insects are its principal food.

Of all the trogons none are so magnificent as the *trogon resplendens*, lately introduced to the knowledge of the scientific world, as a distinct species by Mr Gould, and admirably figured in his splendid "Monograph" of the family *trogonidæ*. This bird, as stated by Mr Gould, "is to be found only in the dense and gloomy forests of the Southern States of Mexico." Little known to Europeans, except within the last few years, the brilliant plumes which fall over the tail (and which, as is the whole of the upper surface of the body of this bird, are of the richest metallic golden green;) were made use of by the ancient Mexicans, as ornaments on their head-dresses; and gorgeous must a head-dress be, composed of such feathers—soft, flowing, of dazzling lustre, and three feet in length. In later times they have occasionally been transmitted as curiosities to Europe.

cry, which throws terror and confusion into the whole insect tribe. They creep hither and thither, seeking for safety; while the bird luxuriously feasts upon them at leisure, darting its tongue with unerring certainty, and devouring the whole brood.

The woodpecker, however, does not confine its depredations solely to trees, but sometimes lights upon the ground, to try its fortune at an ant-hill. It is not so secure of prey there as in the former case, although the numbers are much greater. They lie generally too deep for the bird to come at them; and it is obliged to make up by stratagem the defect of power. The woodpecker first goes to their hills, which it pecks, in order to call them abroad; it then thrusts out its long red tongue, which being like a worm, and resembling their usual prey, the ants come out to settle upon, in great numbers; however, the bird watching the properest opportunity, withdraws its tongue at a jerk, and devours the devourers. This stratagem it continues till it has alarmed their fears; or till it is quite satisfied.[1]

As the woodpecker is obliged to make holes in trees to procure food, so is it also to make cavities still larger to form its nest, and to lay in. This is performed, as usual, with the bill; although some have affirmed that the animal uses its tongue as a gimblet to bore with. But this is a mistake; and those that are curious, may often hear the noise of the bill making its way in large woods and forests. The woodpecker chooses, however, for this purpose, trees that are decayed, or wood that is soft, like beech, elm, and poplar. In these, with very little trouble, it can make holes as exactly round as a mathematician could with compasses. One of these holes the bird generally chooses for its own use, to nestle and bring up its young in; but as they are easily made, it is delicate in its choice, and often makes twenty before one is found fit to give entire satisfaction. Of those which it has made and deserted, other birds, not so good borers, and less delicate in their choice, take possession. The jay and the starling lay their eggs in these holes; and bats are now and then found in peaceable possession. Boys sometimes have thrust in their hands with certain hopes of plucking out a bird's egg; but to their great mortification, have had their fingers bitten by a bat at the bottom.

The woodpecker takes no care to line its nest with feathers or straw; its eggs are deposited in the hole, without any thing to keep them warm, except the heat of the parent's body. Their number is generally five or six; always white, oblong, and of a middle size. When the young are excluded, and before they leave the nest, they are adorned with a scarlet plumage under the throat, which adds to their beauty.[2]

[1] The *Wryneck*, (See Plate XV. fig. 9.) so called from a habit of turning the neck, bears a close analogy to the woodpeckers, in the extensibility of the tongue, and the position of the toes. This bird darts its long tongue into an ant hill, and draws it out loaded with ants, which are retained by the viscous liquid which covers it.

[2] *Ivory-billed Woodpecker.*—"This majestic, and formidable species, (says Wilson, in his American Ornithology) in strength and magnitude stands at the head of the whole class of woodpeckers hitherto discovered.



He may be called the king or chief of his tribe; and nature seems to have designed him a distinguished characteristic in the superb carmine crest and bill of polished ivory with which she has ornamented him. His eye is brilliant and daring; and his whole frame so admirably adapted for his mode of life, and method of procuring subsistence, as to impress on the mind of the examiner the most reverential ideas of the Creator. His manners have also a dignity in them superior to the common herd of woodpeckers. Trees, shrubbery, orchards, rails, fence posts, and old prostrate logs, are alike interesting to those, in their humble and indefatigable search for prey; but the royal hunter now before us, scorns the humility of such situations, and seeks the most towering trees of the forest; seeming particularly attached to those prodigious cypress swamps, whose crowded giant sons stretch their bare and blasted, or moss-hung arms midway to the skies. In these almost inaccessible recesses, amid ruinous piles of impending timber, his trumpet-like note and loud strokes resound through the solitary savage wilds, of which he seems the sole lord and inhabitant. Wherever he frequents, he leaves numerous monuments of his industry behind him. We there see enormous pine trees with cart-loads of bark lying around their roots, and chips of the trunk itself in such quantities as to suggest the idea that half a dozen of axe-men had been at work there for the whole morning. The body of the tree is also disfigured with such numerous and so large excavations, that one can hardly conceive it possible for the whole to be the work of a woodpecker. With such strength, and an apparatus so powerful, what havoc might he not commit, if numerous, on the most useful of our forest trees! and yet with all these appearances, and much of vulgar prejudice against him, it may fairly be questioned whether he is at all injurious; or, at least, whether his exertions do not contribute most powerfully to the protection of our timber. Examine closely the tree where he has been at work, and you will soon perceive, that it is neither from motives of mischief nor amusement that he slices off the bark, or digs his way into the trunk.—For

In our climate, this bird is contented with such a wainscot habitation as has been described for its young; but in the warmer regions of Guinea and Brazil, they take a very different method to protect and hatch their nascent progeny. (For Megellannic Woodpecker, see Plate XVI. fig. 36.) A traveller who walks into the forests of these countries, among the first strange objects that excite curiosity, is struck with the multitude of birds' nests hanging at the extremity of almost every branch. Many other kinds of birds

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the sound and healthy tree is the least object of his attention. The diseased, infested with insects, and hastening to putrefaction, are *his* favourites; there the deadly crawling enemy have formed a lodgement between the bark and tender wood, to drink up the very vital part of the tree. It is the ravages of these vermin which the intelligent proprietor of the forest deplores, as the sole perpetrators of the destruction of his timber. Would it be believed that the larvæ of an insect, or fly, no larger than a grain of rice, should silently, and in one season, destroy some thousand acres of pine trees, many of them from two to three feet in diameter, and a hundred and fifty feet high! Yet whoever passes along the high road from Georgetown to Charleston, in South Carolina, about twenty miles from the former place, can have striking and melancholy proofs of this fact. In some places the whole woods, as far as you can see around you, are dead, stripped of the bark, their wintry-looking arms and bare trunks bleaching in the sun, and tumbling in ruins before every blast, presenting a frightful picture of desolation. And yet ignorance and prejudice stubbornly persist in directing their indignation against the bird now before us, the constant and mortal enemy of these very vermin, as if the hand that probed the wound to extract its cause, should be equally detested with that which inflicted it; or as if the thief-catcher should be confounded with the thief. Until some effectual preventive or more complete mode of destruction can be devised against these insects, and their larvæ, I would humbly suggest the propriety of protecting, and receiving with proper feelings of gratitude, the services of this and the whole tribe of woodpeckers, letting the odium of guilt fall to its proper owners.

"In looking over the accounts given of the ivory-billed woodpecker by the naturalists of Europe, I find it asserted, that it inhabits from New Jersey to Mexico. I believe, however, that few of them are ever seen to the north of Virginia, and very few of them even in that state. The first place I observed this bird at, when on my way to the south, was about twelve miles north of Wilmington in North Carolina. Having wounded it slightly in the wing, on being caught, it uttered a loudly reiterated and most piteous note, exactly resembling the violent crying of a young child; which terrified my horse so, as nearly to have cost me my life. It was distressing to hear it. I carried it with me in the chair, under cover, to Wilmington. In passing through the streets, its affecting cries surprised every one within hearing, particularly the females, who hurried to the doors and windows with looks of alarm and anxiety. I drove on, and, on arriving at the piazza of the hotel, where I intended to put up, the landlord came forward, and a number of other persons who happened to be there, all equally alarmed at what they heard; this was greatly increased by my asking, whether he could furnish me with accommodations for myself and my baby. The man looked blank and foolish, while the others stared with still greater astonishment. After diverting myself for a minute or two at their expense, I drew my woodpecker from under the cover, and a general laugh took place. I took him up stairs and locked him up in my room, while I went to see my horse taken care of. In less than an hour I returned, and, on opening the door, he set up the same distressing shout, which now appeared to proceed from grief that he had been discovered in his attempts at escape. He had mounted along the side of the window, nearly as high as the ceiling, a little below which he had begun to break through. The bed was covered with large pieces of plaster; the lath was exposed for at least fifteen inches square, and a hole large enough to admit the fist, opened to the weather-boards; so that in less than another hour he would certainly have succeeded in making his way through. I now tied a string round his leg, and, fastening it to the table, again left him. I wished to preserve his life, and had gone off in search of suitable food for him. As I re-ascended the stairs I heard him again hard at work, and on entering had the mortification to perceive that he had almost entirely ruined the mahogany table to which he was fastened, and on which he had wreaked his whole vengeance. While engaged in taking a drawing, he cut me severely in several places, and, on the whole, displayed such a noble and unconquerable spirit, that I was frequently tempted to restore him to his native woods. He lived with me nearly three days, but refused all sustenance, and I witnessed his death with regret."

Gold-winged Woodpecker.—"In rambling through the woods one day," continues Wilson, "I happened to shoot one of these birds, and wounded him slightly on the wing. Finding him in full feather, and seemingly but little hurt, I took him home, and put him into a large cage, made of willows, intending to keep him in my own room, that we might become better acquainted. As soon as he found himself inclosed on all sides, he lost no time in idle fluttering, but, throwing himself against the bars of the cage, began instantly to demolish the willows, battering them with great vehemence, and uttering a loud piteous kind of cackling, similar to that of a hen when she is alarmed, and takes to wing. Poor Baron Trenck never laboured with more eager diligence at the walls of his prison, than this son of the forest in his exertions for liberty; and he exercised his powerful bill with such force, digging into the sticks, seizing and shaking them so from side to side, that he soon opened for himself a passage; and though I repeatedly repaired the breach, and barricaded every opening, in the best manner I could, yet on my return into the room, I always found him at large, climbing up the chairs, or running about the floor, where, from the dexterity of his motions, moving backward, forward, and sidewise, with the same facility, it became difficult to get hold of him again. Having placed him in a strong wire cage, he seemed to give up all hopes of making his escape, and soon became very tame; fed on young ears of Indian corn; refused apples, but ate the berries of the sour gum greedily, small winter grapes, and several other kinds of berries; exercised himself frequently in climbing, or rather hopping perpendicularly along the sides of the cage; and, as evening drew on, fixed himself in a high hanging, or perpendicular position, and slept with his head in his wing. As soon as dawn appeared, even before it was light enough to perceive him distinctly across the room, he descended to the bottom of the cage, and began his attack on the ears of Indian corn, rapping so loud, as to be heard from every room in the house. After this he would sometimes resume his former position, and take another nap. He was beginning to become very amusing, and even sociable, when, after a lapse of several weeks, he became drooping, and died, as I conceived, from the effects of his wound."

Red-headed Woodpecker.—"There is perhaps no bird in North America more universally known than

build in this manner, but the chief of them are of the woodpecker kind; and indeed there is not, in the whole history of nature, a more singular instance of the sagacity of those little animals in protecting themselves against such enemies as they have most occasion to fear. In cultivated countries, a great part of the caution of the feathered tribe is to hide or de-

this. His tri-coloured plumage, red, white, and black, glossed with steel blue, is so striking, and characteristic;



and his predatory habits in the orchards and cornfields, added to his numbers, and fondness for hovering along the fences, so very notorious, that almost every child is acquainted with the red-headed woodpecker. In the immediate neighbourhood of our large cities, where the old timber is chiefly cut down, he is not so frequently found; and yet at this present time, June, 1808, I know of several of their nests within the boundaries of the city of Philadelphia. Two of these are in button-wood trees (*platanus occidentalis*,) and another in the decayed limb of a large elm. The old ones, I observe, make their excursions regularly to the woods beyond the Schuylkill, about a mile distant; preserving great silence and circumspection in visiting their nests,—precautions not much attended to by them in the depth of the woods, because there the prying eye of man is less to be dreaded. Towards the mountains, particularly in the vicinity of creeks and rivers, these birds are extremely abundant, especially in the latter end of summer. Wherever you travel in the interior at that season, you hear them screaming from the adjoining woods, rattling on the dead limbs of trees, or on the fences, where they are perpetually seen flitting from stake to stake, on the road-side, before you. Wherever there is a tree, or trees, of the wild cherry, covered with ripe fruit, there you see them busy among the branches; and, in passing orchards, you may easily know where to find the earliest, sweetest apples, by observing those trees, on or near which the red-headed woodpecker is skulking; for he is so excellent a connoisseur in fruit, that wherever an apple or pear tree is found broached by him, it is sure to be among the ripest and best flavoured: when alarmed, he seizes a capital one by striking his open bill deep into it, and bears it off to the woods. When the Indian corn is in its rich, succulent, milky state, he attacks it with great eagerness, opening a passage through the numerous folds of the husk, and feeding on it with voracity. The girdled, or deadened timber, so common among cornfields in the back settlements, are his favourite retreats, whence he sallies out to make his depredations. He is fond of the ripe berries of the sour gum, and pays pretty regular visits to the cherry trees, when loaded with fruit. Towards fall he often approaches the barn or farm house, and raps on the shingles and weather boards: he is of a gay and frolicsome disposition; and half a dozen of the fraternity are frequently seen diving and vociferating around the high dead limbs of some large tree, pursuing and playing with each other, and amusing the passenger with their gambols. Their note or cry is shrill and lively, and so much resembles that of a species of tree-frog, which frequents the same tree, that it is sometimes difficult to distinguish the one from the other.

"Such are the *vicious* traits, if I may so speak, in the character of the red-headed woodpecker; and I doubt not but, from what has been said on this subject, that some readers would consider it meritorious to exterminate the whole of this tribe as a nuisance: and, in fact, the legislature of some of our provinces, in former times, offered premiums to the amount of twopence per head for their destruction. But let us not condemn the species unheard: they exist; they must therefore be necessary. If their merits and usefulness be found, on examination, to preponderate against their vices, let us avail ourselves of the former, while we guard as well as we can against the latter.

"Though this bird occasionally regales himself on fruit, yet his natural and most usual food is insects, particularly those numerous and destructive species that penetrate the bark and body of the tree to deposite their eggs and larvæ, the latter of which are well known to make immense havoc. That insects are his natural food is evident from the construction of his wedge-formed bill, the length, elasticity, and figure of his tongue, and the strength and position of his claws; as well as from his usual habits. In fact, insects form at least two-thirds of his subsistence; and his stomach is scarcely ever found without them. He searches for them with a dexterity and intelligence, I may safely say, more than human; he perceives, by the exterior appearance of the bark, where they lurk below; when he is dubious, he rattles vehemently on the outside with his bill, and his acute ear distinguishes the terrified vermin shrinking within to their inmost retreats, where his pointed and barbed tongue soon reaches them. The masses of bugs, caterpillars, and other larvæ, which I have taken from the stomachs of these birds, have often surprised me. These larvæ, it should be remembered, feed not only on the buds, leaves, and blossoms, but on the very vegetable life of the tree, the alburnum, or newly forming bark and wood; the consequence is, that whole branches and whole trees decay under the silent ravages of these destructive vermin; witness the late destruction of many hundred acres of pine trees, in the north-eastern parts of South Carolina; and the thousands of peach trees that yearly decay from the same cause. Will any one say, that, taking half a dozen, or half a hundred, apples from a tree is equally ruinous with cutting it down? or, that the services of a useful animal should not be rewarded with a small portion of that which it has contributed to preserve? We are told, in the benevolent language of the scriptures, not to muzzle the mouth of the ox that treadeth out the corn; and why should not the same generous liberality be extended to this useful family of birds, which forms so powerful a phalanx against the inroads of many millions of destructive vermin?

"Notwithstanding the care which this bird, in common with the rest of its genus, takes to place its young beyond the reach of enemies, within the hollows of trees, yet there is one deadly foe, against whose depredations neither the height of the tree, nor the depth of the cavity, is the least security. This is the black snake (*coluber constrictor*), who frequently glides up the trunk of the tree, and, like a sculking savage, enters the woodpecker's peaceful apartment, devours the eggs or helpless young, in spite of the cries and flutterings of the parents; and if the place be large enough, coils himself up in the spot they occupied, where he will sometimes remain for several days. The eager school-boy, after hazarding his

fend their nests from the invasions of man; as he is their most dreaded enemy. But in the depth of those remote and solitary forests, where man is but seldom seen, the little bird has nothing to apprehend from man. The parent is careless how much the nest is exposed to general notice; satisfied if it be out of the reach of those rapacious creatures that live

neck to reach the woodpecker's hole, at the triumphant moment when he thinks the nestlings his own, and strips his arm, launching it down into the cavity, and grasping what he conceives to be the callow young, starts with horror at the sight of a hideous snake, and almost drops from his giddy pinnacle, retreating down the tree with terror and precipitation. Several adventures of this kind have come to my knowledge; and one of them that was attended with serious consequences, where both snake and boy fell to the ground; and a broken thigh, and long confinement, cured the adventurer completely of his ambition for robbing woodpeckers' nests."

Downy Woodpecker.—"This is the smallest of our woodpeckers, and so exactly resembles the former (the



hairy woodpecker) in its tints and markings, and in almost every thing except its diminutive size, that I wonder how it passed through the Count de Buffon's hands without being branded as a "spurious race, degenerated by the influence of food, climate, or some unknown cause." But, though it has escaped this infamy, charges of a much more heinous nature have been brought against it, not only by the writer above mentioned, but by the whole venerable body of zoologists in Europe, who have treated of its history, viz. that it is almost constantly boring and digging into apple-trees; and that it is the most destructive of its whole genus to the orchards. The first part of this charge I shall not pretend to deny; how far the other is founded in truth will appear in the sequel. Like the two former species, it remains with us the whole year. About the middle of May, the male and female look out for a suitable place for the reception of their eggs and young. An apple, pear, or cherry tree, often in the near neighbourhood of the farm-house, is generally pitched upon for this purpose. The tree is minutely reconnoitred for several days previous to the operation, and the work is first begun by the male, who cuts out a hole in the solid wood, as circular as if described with a pair of compasses. He is occasionally relieved by the female, both parties working with the most indefatigable diligence. The direction of the hole, if made in the body of the tree, is generally downwards, by an angle of thirty or forty degrees, for the distance of six or eight inches, and then straight down for ten or twelve more; within roomy, capacious, and as smooth as if polished by the cabinet-maker; but the entrance is judiciously left just so large as to admit the bodies of the owners. During this labour, they regularly carry out the chips, often strewing them at a distance to prevent suspicion. This operation sometimes occupies the chief part of a week. Before she begins to lay, the female often visits the place, passes out and in, examines every part both of the exterior and interior, with great attention, as every prudent tenant of a new house ought to do, and at length takes complete possession. The eggs are generally six, pure white, and laid on the smooth bottom of the cavity. The male occasionally supplies the female with food while she is sitting; and about the last week in June the young are perceived making their way up the tree, climbing with considerable dexterity. All this goes on with great regularity where no interruption is met with; but the house wren, who also builds in the hollow of a tree, but who is neither furnished with the necessary tools nor strength for excavating such an apartment for himself, allows the woodpeckers to go on, till he thinks it will answer his purpose, then attacks them with violence, and generally succeeds in driving them off. I saw some weeks ago a striking example of this, where the woodpeckers we are now describing, after commencing in a cherry-tree within a few yards of the house, and having made considerable progress, were turned out by the wren; the former began again on a pear tree in the garden, fifteen or twenty yards off, whence, after digging out a most complete apartment, and one egg being laid, they were once more assaulted by the same impertinent intruder, and finally forced to abandon the place.

"The principal characteristics of this little bird are diligence, familiarity, perseverance, and a strength and energy in the head and muscles of the neck, which are truly astonishing. Mounted on the infected branch of an old apple-tree, where insects have lodged their corroding and destructive brood in crevices between the bark and wood, he labours sometimes for half an hour incessantly at the same spot, before he has succeeded in dislodging and destroying them. At these times you may walk up pretty close to the tree and even stand immediately below it, within five or six feet of the bird, without in the least embarrassing him; the strokes of his bill are distinctly heard several hundred yards off; and I have known him to be at work for two hours together on the same tree. Buffon calls this "incessant toil and slavery," their attitude "a painful posture," and their life "a dull and insipid existence;" expressions improper, because untrue; and absurd, because contradictory. The posture is that for which the whole organization of his frame is particularly adapted; and though, to a wren or a humming-bird, the labour would be both toil and slavery, yet to him it is, I am convinced, as pleasant and as amusing, as the sports of the chase to the hunter, or the sucking of flowers to the humming-bird. The eagerness with which he traverses the upper and lower sides of the branches; the cheerfulness of his cry, and the liveliness of his motions while digging into the tree and dislodging the vermin, justify this belief. He has a single note, or *chinck*, which, like the former species, he frequently repeats. And when he flies off, or alights on another tree, he utters a rather shriller cry, composed of nearly the same kind of note, quickly reiterated. In fall and winter, he associates with the titmouse, creeper, &c. both in their wood and orchard excursions; and usually leads the van. Of all our woodpeckers, none rid the apple-trees of so many vermin as this, digging off the moss which the negligence of the proprietor had suffered to accumulate, and probing every crevice. In fact, the orchard is his favourite resort in all seasons; and his industry is unequalled, and almost incessant, which is more than can be said of any other species we have. In fall, he is particularly fond of boring the apple-trees for insects, digging a circular hole through the bark just sufficient to admit his bill, after that a second, third,

by robbery and surprise. If the monkey or the snake can be guarded against, the bird has no other enemies to fear; for this purpose its nest is built upon the depending points of the most outward branches of a tall tree, such as the banana, or the plantain. On one of those immense trees, is seen the most various and the most inimical assemblage of creatures that can be imagined. The top is inhabited by monkeys of some particular tribe, that drive off all others; lower down twine about the great trunk numbers of the larger snakes, patiently waiting till some unwary animal comes within the sphere of their activity, and at the edges of the tree hang these artificial nests, in great abundance, inhabited by birds of the most delightful plumage.

The nest is usually formed in this manner: when the time of incubation approaches, they fly busily about, in quest of a kind of moss, called by the English inhabitants of those countries, *old man's beard*. It is a fibrous substance, and not very unlike hair, which bears being moulded into any form, and suffers being glued together. This therefore the little woodpecker, called by the natives of Brazil, the *guiratemga*, first glues, by some viscous substance gathered in the forest, to the extremest branch of a tree; then building downward, and still adding fresh materials to those already procured, a nest is formed, that depends, like a pouch, from the point of the branch: the hole to enter at, is on the side; and all the interior parts are lined with the finer fibres of the same substance, which compose the whole.

Such is the general contrivance of these hanging nests; which are made, by some other birds, with still superior art. A little bird of the Grosbeak kind, in the Philippine islands, makes its nest in such a manner that there is no opening but from the bottom. At the bottom the bird enters, and goes up through a funnel like a chimney, till it comes to the real door of the nest, which lies on one side, and only opens into this funnel.

Some birds glue their nest to the leaf of the banana tree, which makes two sides of their little habitation; while the other two are artificially composed by their own industry. But these, and all of the kind, are built with the same precautions to guard the young against the depredations of monkeys and serpents, which abound in every tree. The nest hangs there before the spoilers, a tempting object, which they can only gaze upon, while the bird flies in and out, without danger or molestation from so formidable a vicinity.[1]

&c., in pretty regular horizontal circles round the body of the tree; these parallel circles of holes are often not more than an inch or an inch and a half apart, and sometimes so close together, that I have covered eight or ten of them at once with a dollar. From nearly the surface of the ground up to the first fork, and sometimes far beyond it, the whole bark of many apple-trees is perforated in this manner, so as to appear as if made by successive discharges of buck-shot; and our little woodpecker, the subject of the present account, is the principal perpetrator of this supposed mischief. I say supposed, for so far from these perforations of the bark being ruinous, they are not only harmless, but, I have good reason to believe, really beneficial to the health and fertility of the tree. I leave it to the philosophical botanist to account for this; but the fact I am confident of. In more than fifty orchards which I have myself carefully examined, those trees which were marked by the woodpecker (for some trees they never touch, perhaps because not penetrated by insects,) were uniformly the most thriving, and seemingly the most productive; many of these were upwards of sixty years old, their trunks completely covered with holes, while the branches were broad, luxuriant, and loaded with fruit. Of decayed trees, more than three-fourths were untouched by the woodpecker. Several intelligent farmers, with whom I have conversed, candidly acknowledge the truth of these observations, and with justice look upon these birds as beneficial; but the most common opinion is, that they bore the trees to suck the sap, and so destroy its vegetation; though pine and other resinous trees, on the juices of which it is not pretended they feed, are often found equally perforated. Were the sap of the tree their object, the saccharine juice of the birch, the sugar maple, and several others, would be much more inviting, because more sweet and nourishing than that of either the pear or apple-tree; but I have not observed one mark on the former for ten thousand that may be seen on the latter; besides, the early part of spring is the season when the sap flows most abundantly; whereas it is only during the months of September, October, and November, that woodpeckers are seen so indefatigably engaged in orchards, probing every crack and crevice, boring through the bark, and what is worth remarking, chiefly on the south and southwest sides of the tree, for the eggs and larvæ deposited there by the countless swarms of summer insects. These, if suffered to remain, would prey upon the very vitals, if I may so express it, of the tree, and in the succeeding summer give birth to myriads more of their race, equally destructive.

"Here, then, is a whole species, I may say, genus, of birds, which Providence seems to have formed for the protection of our fruit and forest trees from the ravages of vermin, which every day destroy millions of those noxious insects that would otherwise blast the hopes of the husbandman; and which even promote the fertility of the tree; and, in return, are proscribed by those who ought to have been their protectors; and incitements and rewards held out for their destruction! Let us examine better into the operations of nature, and many of our mistaken opinions and groundless prejudices will be abandoned for more just, enlarged, and humane modes of thinking."—*Wilson's American Ornithology.*

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[1] The characters of the Nut-hatch tribe are, a bill for the most part straight, having on the lower mandible a small angle: small nostrils, covered with bristles: a short tongue, horny at the end, and jagged: toes placed three forwards, and one backwards; the middle toe joined closely at the base to both the outer, and the back toe as large as the middle one. In the habits and manners of the different species of the nut-hatch, we observe a very close alliance to the woodpeckers. Most of them feed upon insects; and some on nuts, whence their English appellation has been acquired. For Slender Nut-hatch, see Plate XV. fig. 17.

The *European Nut-hatch.* The length of this bird is five inches and three quarters. The bill is strong

CHAP. V.

OF THE BIRD OF PARADISE AND ITS VARIETIES.

THERE are few birds that have more deceived and puzzled the learned than this. Some have described it as an inhabitant of the air, living only upon the dew of heaven, and never resting below; others have acquiesced in the latter part of its history, but have given it flying insects to feed on. Some have asserted that it was without feet, and others have ranked it among the birds of prey.

The great beauty of this bird's plumage, and the deformity of its legs, seem to have given rise to most of these erroneous reports. The native savages of the Molucca Islands, of which it is an inhabitant, were very little

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and straight, about three quarters of an inch long; the upper mandible is black, and the lower white. All the



upper parts of the body are of a bluish gray: the cheeks and chin are white: the breast and belly pale orange colour; and the quills dusky: the tail is short, and consists of twelve feathers; the two middle ones of which are gray, the two outer spotted with white, and the rest dusky. The legs are pale yellow; the claws are large, and the back one very strong. The nut-hatch, the squirrel, and the field-mouse, which all live much on hazel nuts, have each a curious way of getting at the kernel. Of the two latter, the squirrel, after rasping off the small end, splits the shell in two with his long fore-teeth, as a man does with his knife; the field-mouse nibbles a hole with his teeth, as regular as if drilled with a wimble, and yet so small that one would wonder how the kernel could be extracted through it; while the nut-hatch picks an irregular ragged hole with his bill. But as this last artist has no paws to hold the nut firm while he pierces it, he, like an adroit workman, fixes it as it were in a vice, in some cleft of a tree, or in some crevice, when standing over it he perforates the stubborn shell. On placing nuts in the chink of a gate-post, where nut-hatches have been known to haunt, it has always been found that these birds have readily penetrated them. While at work they make a rapping noise, which may be heard a considerable distance. Dr Plott informs us, that this bird, by putting his bill into a crack in the bough of a tree, sometimes makes a violent sound, as if the branch was rending asunder. Besides nuts it feeds also on caterpillars, beetles, and various other insects. The female deposits her eggs, six or seven in number, in some hole of a tree, frequently in one that has been deserted by the woodpecker, on rotten wood mixed with moss. If the entrance be too large, she nicely stops up part of it with clay, leaving only a small hole for herself to pass in and out. When the hen is sitting, if a stick be put in the hole, she hisses like a snake; and she is so much attached to her eggs, that she will sooner suffer any one to pluck off her feathers than fly away. During the time of incubation, she is assiduously attended by the male, who supplies her with food. If the barrier of plaster at the entrance of the hole be destroyed, while these birds have eggs, it is speedily replaced; a peculiar instinct, to prevent their nest from being destroyed by woodpeckers, and other birds of superior size and strength, which build in similar situations. The nut-hatch is not supposed to sleep perched, like most other birds, on a twig; for it has been observed, that when kept in a cage, notwithstanding it would perch now and then, yet at night it generally crept into some hole or corner to sleep. And it is remarkable, when perched, or otherwise at rest, it had mostly the head downwards, or at least even with the body, and not elevated like other birds.

Allied to the Nut-hatch are the *Creepers* and *Hoopœs*. (For Black and White Creeper, see Plate XV. fig. 18; Azure Creeper, Plate XVI. fig. 16; Wall Creeper, ib. fig. 43. For Hoopœ, see Plate XV. fig. 31.) Creepers scale trees in the same manner as woodpeckers, and, like them, are supported behind by their stiff deflected tail. They feed entirely on insects. The hoopœ is widely spread over Europe in the summer months, and is abundant in the South. Sweden is mentioned by some as its northern limit, where the country people are said to consider its appearance as ominous; and in Great Britain it was formerly looked upon by the same class as the harbinger of some calamity. Montagu relates that it is plentiful in the Russian and Tartarian deserts; and Sonnini saw it on the banks of the Nile: Africa indeed and Asia are supposed to be its winter quarters. In a state of nature moist localities are the chosen haunts of the hoopœ. There it may be seen on the ground, busily searching with its long bill for its favourite insects, (chiefly coleopterous) which it often finds in cow-dung, and in the droppings of other animals; and sometimes it may be observed hanging from the branches of trees, examining the under side of the leaves for those which there lie hid. The hole of a decayed tree is the locality generally preferred for the nest, which is made of dried grass lined with feathers, wool or other soft materials, and is generally very fetid from the remains of the insects, &c., with which the parent-birds have supplied their young. This offensive odour most probably gave rise to the story adopted by Aristotle, that the nest of the hoopœ was formed of the most disgusting materials. When a hollow tree is not to be found, the places selected are sometimes the fissures of rocks, and the crevices of old buildings. The eggs are generally four or five in number, of a grayish-white spotted with deep gray or hair-brown.

Few birds are more entertaining in captivity: its beautiful plumage, droll gesticulations and familiar habits, soon make it a favourite. When it perceives that it is observed it begins to tap with its bill against the ground, (which, as Bechstein observes, gives it the appearance of walking with a stick,) at the same time often shaking its wings and tail, and elevating its crest. This latter feat, which is performed very frequently and especially when the bird is surprised or angry, is effected by a muscle situated on the upper part of the head for the purpose. Its note of anger or fear is harsh and grating, something like the noise made by a small saw when employed in sawing, or the note of a jay, but not so loud. It gives utterance to a soft note of complacency occasionally, and is not without other intonations. The grating note is not always indicative of anger or fear, for the bird generally exerts it when it flies up, and settles on its perch.

studious of natural history; and, perceiving the inclination the Europeans had for this beautiful bird, carefully cut off its legs before they brought it to market; thus concealing its greatest deformity, they considered themselves entitled to rise in their demands when they offered it for sale. One deceit led on to another; the buyer finding the bird without legs, naturally inquired after them; and the seller as naturally began to assert that it had none. Thus far the European was imposed upon by others; in all the rest he imposed upon himself. Seeing so beautiful a bird without legs, he concluded that it could live only in air, where legs were unnecessary. The extraordinary splendour of its plumage assisted this deception; and, as it had heavenly beauty, so it was asserted to have a heavenly residence. From thence its name, and all the false reports that have been propagated concerning it.[1]

Error, however, is short lived; and time has discovered that this bird not only has legs, but very large strong ones for its size. Credulity, when undeceived, runs into the opposite extreme; and soon after this harmless bird was branded with the character of being rapacious, of destroying all those of smaller size, and from the amazing rapidity of its flight, as qualified peculiarly for extensive rapine. The real history of this pretty animal is at present tolerably well known; and it is found to be as harmless as it is beautiful.

There are two kinds of the bird of Paradise,[2] one about the size of a pigeon, which is more common; the other not much larger than a lark, which has been described more imperfectly. They are both sufficiently distinguished from all other birds, not only by the superior vivacity of their tints, but by the feathers of the tail, there being two long slender filaments growing from the upper part of the rump; these are longer than the bird's body, and bearded only at the end. By this mark the bird of Paradise may be easily known, but still more easily by its gaudy livery, which, being so very brilliant, demands to be minutely described.

This bird appears to the eye as large as a pigeon, though in reality the body is not much greater than that of a thrush. The tail, which is about six inches, is as long as the body; the wings are large, compared with the bird's other dimensions. The head, the throat, and the neck, are of a pale gold colour. The base of the bill is surrounded by black feathers, as also the side of the head and throat, as soft as velvet, and changeable like those on the neck of a mallard. The hinder part of the head is of a shining green, mixed with gold. The body and wings are chiefly covered with beautiful brown, purple, and gold feathers. The uppermost part of the tail-feathers are of a pale yellow, and those under them white, and longer than the former; for which reason the hinder part of the tail appears to be all white. But what chiefly excites curiosity are, the two long naked feathers above mentioned, which spring from the upper part of the rump above the tail, and which are usually about three feet long. These are bearded only at the beginning and the end; the whole shaft, for about two feet nine inches, being of a deep black, while the feathered extremity is of a changeable colour, like the mallard's neck.

This bird, which for beauty exceeds all others of the pie kind, is a native of the Molucca islands, but found in greatest numbers in that of Aro. There, in the delightful and spicy woods of the country, do these beautiful creatures fly in large flocks; so that the groves which produce the richest spices produce the finest birds also. The inhabitants themselves are not insensible of the pleasure these afford, and give them the name of God's birds, as being superior to all others that he has made. They live in large flocks, and at night generally perch upon the same tree. They are called by some, the *swallows of Ternate*, from their rapid flight, and from their being continually on the wing in pursuit of insects, their usual prey.

As the country where they are bred has its tempestuous season, when rains and thunders continually disturb the atmosphere, these birds are then but seldom seen. It is thought that they then fly to other countries, where their food appears in greater abundance; for, like swallows, they have their stated times of return. In the beginning of the month of August, they are seen in great numbers flying together; and as the inhabitants would have us believe, following their king, who is distinguished from the rest by the lustre of his plumage, and that respect and veneration which is paid him.[3] In the evening they

[1] The natives of the New Guinea islands, in preparing the skins of the birds of paradise, removed the true wings, which are not so brilliant as the other feathers, and cut off the legs. Hence, the absence of feet in all the specimens brought to Europe, gave rise to the fable that these birds had no power of alighting, and were always on the wing.

[2] Nearly a dozen species have been discovered. See a succeeding note.

[3] They always migrate in flocks of thirty or forty, and have a leader, which the inhabitants of Aro call the king. He is said to be black, to have red spots, and to fly far above the flock, which never desert him, but always settle in the same place that he does. They never fly with the wind, as in that case their loose plumage would be ruffled, and blown over their heads; and a change of wind often compels them to alight on the ground, from which they cannot rise without great difficulty. When

perch upon the highest trees of the forest, particularly one which bears a red berry, upon which they sometimes feed, when other food fails them. In what manner they breed, or what may be the number of their young, as yet remains for discovery.

The natives, who make a trade of killing and selling these birds to the European, generally conceal themselves in the trees where they resort, and having covered themselves up from sight in a bower made of the branches, they shoot at birds with reedy arrows; and, as they assert, if they happen to kill the king, they then have a good chance for killing the greatest part of the flock. The chief marks by which they know the king is by the ends to the feathers in his tail, which have eyes like those of a peacock. When they have taken a number of these birds, their usual method is to gut them, and cut off their legs; they then run a hot iron into the body, which dries up the internal moisture; and filling the cavity with salts and spices, they sell them to the Europeans for a perfect trifle.

they are surprised by a heavy gale, they instantly soar to a higher region, beyond the reach of the tempest. There, in a serene sky, they float at ease on their light flowing feathers, or pursue their journey in security. During their flight they cry like starlings; but when a storm blows in their rear, they express their distressed situation by a note somewhat resembling the croaking of a raven. In calm weather, great numbers of these birds may be seen flying, both in companies and singly, in pursuit of the large butterflies and other insects on which they feed. The general colour of these birds is chestnut, with a neck of a golden green, beneath. The feathers of the back and sides are considerably longer than those of the body. They have two long tail feathers, which are straight, and taper at the tip.

There have been ten species of this bird lately discovered. (For the red-tailed bird of Paradise, see Plate XV. fig. 16; for the gorget bird of Paradise, see Plate XVI. fig. 4.)

The *Grakle bird of Paradise.*—It has a triangular naked space behind the eyes; the head and neck are brown; the bill and legs are yellow; the body brownish; the first quill feathers white, from the base to the middle; the tail feathers, except the middle one, are tipt with white. It inhabits the Philippine islands; is nine and a half inches long; feeds on fruit, insects, mice, and every kind of grain. It builds twice a year, in the forked branches of trees, and lays four eggs. When young it is easily tamed, and becomes docile and imitative. This bird has a great affinity in all its habits to the grakle genus; yet, on account of the downy feathers at the base of the bill, it is placed here.

The *magnificent Bird of Paradise.*—This elegant species, so remarkable for the splendour and variety of its colours, is principally found in the Molucca islands, and is somewhat smaller than the common bird of paradise. The bill is surrounded at the base with velvet-like feathers; the chin is green, with golden lunules; crown with a tuft of yellow feathers; the first quill feathers are brown, and the secondary of a deep yellow; the middle tail feathers are very long, with a very short fringe; its legs and bill are yellow, the latter black at the tip. This beautiful bird inhabits New Holland, and is nine inches long.

The *Lyre bird*, or *Superb Menura.*—New Holland, which affords so rich a harvest to the student of nature, and which produces the most singular and anomalous beings with which we are at present acquainted, is the native country of this rare and beautiful bird, the habits and manners of which are yet but little known. (See Plate XVII. fig. 3.) Considered by many naturalists as allied to the paradiseæ, or birds of Paradise, it exhibits in its general form, and especially in the figure of its large elongated nails, which are evidently adapted for scratching up the soil, a certain degree of approximation to the gallinaceous tribe, to which others are inclined to refer it; but there is, however, a group of *ground thrushes* as they are expressively called, to which, in the characters of the plumage and in habits, it would appear, we think, to be still nearer related.

In size, the menura is about equal to a pheasant. Its general plumage is of a dull brown, inclining to rufous on the quill-feathers; the tail, which is much longer than the body, consists of feathers so arranged, and of such different sorts, as to form, when elevated, a figure bearing no unapt resemblance to an ancient lyre; the position of these feathers will be better conveyed by the figure in the plate than by description: the bill is compressed, the nostrils forming a longitudinal slit, covered with bristle-like feathers; the legs are strong, the toes completely divided, and armed with powerful blunted nails, those of the hind claws being especially developed.

CHAP. VI.

THE CUCKOO, AND ITS VARIETIES.[1]



From a bird of which many fables have been reported, we pass to another that has not

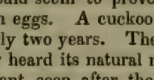
[1] Perhaps few birds have excited more curiosity amongst naturalists than *the Cuckoo*, and some rather contradictory accounts have from time to time been published respecting it. Dr Jenner was the first who threw any light on the natural history of this extraordinary bird: and his account is most interesting and satisfactory. The fact of the young cuckoo turning out its weaker companions, the natural inmates of the nest, is now undisputed. This operation is, I believe, generally performed on the second day after the birds are hatched,—at least, I have found it to be so in the cases which have come under my own observation. The young intruder seems to confine his dislike to his nestling companions to the act of discharging them from the nest. In one instance, which I had an opportunity of observing, the young birds, which had only been hatched two days, were so little hurt by a fall of four feet from the nest to the ground, that two of them contrived to crawl a distance of eight or nine feet from the place on which they had fallen. Sometimes the young cuckoo is hatched before the other birds: in which case he proceeds to discard the eggs, which he is enabled to do by means of a depression in the middle of his back. It seems, how-

given less scope to fabulous invention. The note of the cuckoo is known to all the world; the history and nature of the bird itself still remains in great obscurity. That it devours its parent, that it changes its nature with the season, and becomes a sparrow-hawk, were fables invented of this bird, and are now sufficiently refuted. But where it resides in winter, or how it provides for its supply during that season, still continues undiscovered. This singular bird, which is somewhat less than a pigeon, shaped like a magpie, and of a grayish colour, is distinguished from all other birds by its round prominent nostrils. Having disappeared all the winter, it discovers itself in our country early in the spring, by its well-known call. Its note is heard earlier or later, as the season seems to be more or less

ever, to have escaped the notice of those to whom we are most indebted for the agreeable information we already possess of the habits of the cuckoo, that the parent bird, in depositing her egg, will sometimes undertake the task of removing the eggs of those birds in whose nest she is pleased to place her own.* I say sometimes, because I am aware that it is not always the case; and indeed I have only one fact to bring forward in support of the assertion; it is, however, connected with another relating to the cuckoo, not a little curious. The circumstance occurred at Arbury, in Warwickshire, the seat of Francis Newdigate, Esq., and was witnessed by several persons residing in his house. The particulars were written down at the time by a lady, who bestowed much time in watching the young cuckoo, and I now give them in her own words:—"In the early part of the summer of 1828, a cuckoo, having previously turned out the eggs from a water-wagtail's nest, which was built in a small hole in a garden-wall at Arbury, deposited her own egg in their place. When the egg was hatched, the young intruder was fed by the water-wagtails, till he became too bulky for his confined and narrow quarters, and in a *fidgetty* fit he fell to the ground. In this predicament he was found by the gardener, who picked him up, and put him into a wire-cage, which was placed on the top of a wall, not far from the place of its birth. Here it was expected that the wagtails would have followed their supposititious offspring with food, to support it in its imprisonment—a mode of proceeding which would have had nothing very uncommon to recommend it to notice. But the odd part of the story is, that the bird which hatched the cuckoo never came near it; but her place was supplied by a hedge-sparrow, who performed her part diligently and punctually, by bringing food at very short intervals from morning till evening, till its uncouth foster-child grew large, and became full feathered, when it was suffered to escape, and was seen no more: gone, perhaps, to the country to which he migrates, to tell his kindred cuckoos (if he was as ungrateful as he was ugly when I saw him in the nest) what fools hedge-sparrows and water-wagtails are in England. It may possibly be suggested, that a mistake has been made with regard to the sort of bird which hatched the cuckoo, and that the same bird which fed it, namely, the hedge-sparrow,† hatched the egg. If this had been the case, there would have been nothing extraordinary in the circumstance; but the wagtail was too often seen on her nest, both before the egg was hatched, and afterwards feeding the young bird, to leave room for any scepticism on that point; and the sparrow was seen feeding it in the cage afterwards by many members of the family daily."

This account (the accuracy of which no one can doubt, who is acquainted with the party from whom it comes) seems to prove the assertion which some persons have made, of cuckoos having introduced their eggs into the nest of the wren, or into nests built in holes in the wall; or, as Dr Jenner asserts, in a wagtail's nest in a hole under the eaves of a cottage. Some doubt has been thrown on the accuracy of this statement of Dr Jenner's, in a new and very agreeable edition of Colonel Montague's Ornithological Dictionary: at least, a hint is given that it was rather a singular place for a wagtail to build in. I have, however, found them in similar situations; and one wagtail built amongst the rough bricks which formed some rock-work in my garden. If the fact, therefore, is undoubted, that the egg of the cuckoo is found in the nest of a bird built in so small a hole in a wall that a young cuckoo could no longer remain in it, by what means could she contrive to introduce her egg into the nest? It appears quite impossible that she could have sat on the nest while she deposited her egg; and it is not easy, therefore, to form a probable conjecture how the operation was performed. Spurzheim, however, asserts in his lectures, that he actually saw an instance of a cuckoo having dropped her egg near a nest so placed that she could not possibly gain admittance to it: and that after removing the eggs which were already in the nest, she took up her own egg in one of her feet, and in that way placed it in it.

The following communication from a gentleman in Sussex will throw some new and interesting light on the natural history of the cuckoo. He says, that on firing at a bird sitting on a fir tree in his garden, and which he took for a hawk, it fell with a broken wing. On picking it up, it proved to be a cuckoo, and being in beautiful plumage, and very lively, he tied up the wing, and sent it to a friend at Chichester, who being captivated by the bird's quiet demeanour, determined on trying to keep it alive. On being put into a cage, the bird soon fed, and appeared perfectly reconciled to its loss of freedom. It eat fresh meat of any sort, cut small and mixed with bread scalded and broken, and a raw egg. On this diet the bird did well for three months. At this time a lad brought some yellow-hammer's eggs, intending them as a treat, one of which the bird unexpectedly seized, and attempted to swallow. It stuck, however, in its throat, and killed it in a short time. This would seem to prove that these birds feed sometimes on eggs. A cuckoo was kept at Goodwood-house for nearly two years. The persons who had the care of it never heard its natural note of "Cuckoo." It is not unfrequent soon after the arrival of these birds, to see four or five, or more of them in animated sportiveness on the branches of an oak. If the spectator is attentive, he will soon hear the notes repeated thus,—Hoo-hoo—hoo-hooho-hoo—which, probably, are notes of exultation from the favoured suitor. When a cuckoo is seen in a straight flight, it will often give utterance to a beautiful sound, more like a delicate and lengthened shake on the flute than anything else it can be compared to. As the bird is always alone when this note is heard, we may conclude that it is a call for its mate.—*Jesse's Gleanings, Vol. I.*



* May she not do this in consequence of not being able to find a nest fit for her purpose, and therefore, from some extraordinary and powerful instinct, she removes eggs which would be hatched before her own, and the young birds from which might become too strong and heavy to be ejected from the nest by the young cuckoo? It requires all the exertions and activity of a pair of water-wagtails or hedge-sparrows to provide for a young cuckoo. If there were other birds in the nest, some must starve. The female cuckoo, by ejecting the eggs, prevents this.

† It could not have been the hedge-sparrow, as those birds are never known to build in a hole in a wall.

forward, and the weather more or less inviting. From the cheerful voice of this bird the farmer may be instructed in the real advancement of the year. The fallibility of human calendars is but too well known; but from this bird's note, the husbandman may be taught when to sow his most useful seeds, and to do such work as depends upon a certain temperature of the air. These feathered guides come to us heaven-taught, and point out the true commencement of the season.

The cuckoo, that was silent some time after its appearance, begins and at first feebly, at very distant intervals, to give its call, which as the summer advances, improves both in its frequency and loudness. This is an invitation to courtship, and used only by the male, who sits generally perched upon some dead tree, or bare bough, and repeats his song, which he loses as soon as the genial season is over. His note is pleasant, though uniform; and, from an association of ideas, seldom occurs to the memory without reminding us of the sweets of summer. Custom too has affixed a more ludicrous association to this note; which, however, we that are bachelors need be in no pain about. This reproach seems to arise from this bird's making use of the bed or nest of another to deposit its own brood in.

However this may be, nothing is more certain than that the female makes no nest of her own. She repairs for that purpose to the nest of some other bird, generally the water-wagtail or hedge-sparrow, and having devoured the eggs of the owner, lays her own in their place. She usually lays but one, which is speckled, and of the size of a blackbird's. This the fond foolish bird hatches with great assiduity, and, when excluded, finds no difference in the great ill-looking changeling from her own. To supply this voracious creature, the credulous nurse toils with unusual labour, no way sensible that she is feeding up an enemy to her race, and one of the most destructive robbers of her future progeny.

It was once doubted whether these birds were carnivorous; but Reaumur was at the pains of breeding up several, and found that they would not feed upon bread or corn; but flesh and insects were their favourite nourishment. He found it a very difficult task to teach them to peck; for he was obliged to feed them a full month after they were grown as big as the mother. Insects, however, seemed to be their peculiar food when young; for they devoured flesh by a kind of constraint, as it was always put into their mouths; but meal-worm insects they flew to, and swallowed of their own accord most greedily. Indeed, their gluttony is not be wondered at, when we consider the capacity of their stomach, which is enormous, and reaches from the breast-bone to the vent. It is partly membranous, partly muscular, and of a prodigious capacity; yet still they are not to be supposed as birds of prey, for they have neither the strength nor the courage. On the contrary, they are naturally weak and fearful, as appears by their flying from small birds, which every where pursue them. The young birds are brown, mixed with black; and in that state they have been described by some authors as old ones.

The cuckoo, when fledged and fitted for flight, follows its supposed parent but for a little time; its appetite for insect food increasing, as it finds no great chance for a supply in imitating its little instructor, it parts good friends, the step-child seldom offering any violence to its nurse. Nevertheless, all the little birds of the grove seem to consider the young cuckoo as an enemy, and revenge the cause of their kind by their repeated insults. They pursue it wherever it flies, and oblige it to take shelter in the thickest branches of some neighbouring tree. All the smaller birds form the train of its pursuers; but the wryneck, in particular, is found the most active in the chase; and from thence it has been called by many, the cuckoo's attendant and provider. But it is very far from following with a friendly intention; it only pursues as an insulter, or a spy, to warn all its little companions of the cuckoo's depredations.

Such are the manners of this bird while it continues to reside, or to be seen amongst us. But early, at the approach of winter, it totally disappears, and its passage can be traced to no other country. Some suppose that it lies hid in hollow trees; and others that it passes into warmer climates. Which of these opinions is true is very uncertain, as there are no facts related on either side that can be totally relied on.[1] To support the opinion that they remain torpid during the winter at home, Willoughby introduces the following story, which he delivers upon the credit of another. "The servants of a gentleman, in the country, having stocked up in one of their meadows some old, dry, rotten willows, thought proper, on a certain occasion, to carry them home. In heating a stove, two logs of this timber were put into the furnace beneath, and fire applied as usual. But soon, to the great surprise of the family, was heard the voice of a cuckoo, singing three times from under the stove. Wondering at so extraordinary a cry in the winter time, the servants ran and drew the willow logs from the furnace, and in the midst of one of them saw something move; wherefore,

[1] It is now perfectly ascertained that the cuckoo is a migratory bird. It comes to us late in spring from Northern Africa or Asia Minor, and returns in July or early in autumn.

taking an axe, they opened the hole, and thrusting in their hands, first they plucked out nothing but feathers; afterwards they got hold of a living animal; and this was the cuckoo that had waked so very opportunely for its own safety. It was indeed," continues our historian, "brisk and lively, but wholly naked and bare of feathers, and without any winter provision in its hole. This cuckoo the boys kept two years afterwards alive in the stove; but whether it repaid them with a second song, the author of the tale has not thought fit to inform us."

The most probable opinion on this subject is, that as quails and woodcocks shift their habitations in winter, so also does the cuckoo; but to what country it retires, or whether it has ever been seen on its journey, are questions that I am wholly incapable of resolving.

Of this bird there are many kinds in various parts of the world, not only differing in their colours, but their size. Brisson makes not less than twenty-eight sorts of them; but what analogy they bear to our English cuckoo, I will not take upon me to determine. He talks of one, particularly of Brazil, as making a most horrible noise in the forests; which, as it should seem, must be a very different note from that by which our bird is distinguished at home.[1]

CHAP. VII.

OF THE PARROT, AND ITS AFFINITIES.

The Parrot is the best known among us of all foreign birds, as it unites the greatest beauty with the greatest docility. Its voice also is more like a man's than that of any other; the raven is too hoarse, and the jay and magpie too shrill, to resemble the truth; the parrot's note is of the true pitch, and capable of a number of modulations that even some of our orators might wish in vain to imitate.

The ease with which this bird is taught to speak, and the great number of words which it is capable of repeating, are no less surprising. We are assured by a grave writer, that one of these was taught to repeat a whole sonnet from Petrarch; and that I may not be wanting in my instance, I have seen a parrot belonging to a distiller who had suffered pretty largely in his circumstances from an informer who lived opposite him, very ridiculously employed. This bird was taught to pronounce the ninth commandment, *Thou shalt not bear false witness against thy neighbour*, with a very clear, loud, articulate voice. The bird was generally placed in its cage over against the informer's house, and delighted the whole neighbourhood with its persevering exhortations.

Willoughby tells a story of a parrot, which is not so dull as those usually brought up when this bird's facility of talking happens to be the subject. "A parrot belonging to King Henry VII. who then resided at Westminster, in his palace by the river Thames, had learned to talk many words from the passengers as they happened to take the water. One day, sporting on its perch, the poor bird fell into the water, at the same time crying out, as loud as he could, *A boat! twenty pounds for a boat!* A waterman, who happened to be near, hearing the cry, made to the place where the parrot was floating, and taking him up, restored him to the king. As it seems the bird was a favourite, the man insisted that he ought to have a reward rather equal to his services than his trouble: and, as the parrot had cried twenty pounds, he said the king was bound in honour to grant it. The king at last agreed to leave it to the parrot's own determination, which the bird hearing, cried out, *Give the knave a groat.*"

The parrot, which is so common as a foreign bird with us, is equally so as an indigenous bird in the climates where it is produced. The forests swarm with them; and the rook is not better known with us than the parrot in almost every part of the East and West Indies. It is in vain that our naturalists have attempted to arrange the various species of this bird; new varieties daily offer to puzzle the system-maker, or to demonstrate the narrowness of his catalogues. Linnæus makes the number of its varieties amount to forty-seven; while Brisson doubles the number, and extends his catalogue to

[1] In Europe we possess but one species of the Cuckoo. In Africa there are several species, not the least remarkable of which is called the *Honey-guide Cuckoo*, or Indicator. Its colour is rusty gray, and white beneath; the eyelids are naked, black; shoulders with a yellow spot; the tail is wedged, rusty; the bill is brown at the base, and surrounded with bristles, yellow at the tip; feathers of the thighs white, with a longitudinal black streak; the quill feathers above brown, beneath gray brown; first tail feathers very narrow, and rusty; the next sooty, the inner edge whitish; the rest brown at the tip on the inner web. The honey-guide cuckoo inhabits the interior parts of Africa; is six inches long; is fond of honey; and not being able to procure it from the hollows of trees, by its note it is said to point it out to the inhabitants, who leave it a part for its services, and so highly value it on this account, that it is criminal to destroy it. The accuracy of this statement has been called in question both by Bruce and Le Vaillant, but it is now fully confirmed. There are several varieties of indicators. (For the Great Honey-guide, see Plate XVI. fig. 23; Cupreous Cuckoo, ib. fig. 28; Blue Cuckoo, ib. fig. 29; Senegal Coucal, ib. fig. 30; Malcoho, ib. fig. 31; African Cuckoo, ib. fig. 32; Long-bellied Cuckoo, ib. fig. 19.)

ninety-five.[1] Perhaps even this list might be increased, were every accidental change of colour to be considered as constituting a new species. But, in fact, natural history gains little by these discoveries; and as its dominions are extended it becomes more barren. It is asserted, by sensible travellers, that the natives of Brazil can change the colour of a parrot's plumage by art. If this be true, and I am apt to believe the information, they can make new species at pleasure, and thus cut out endless work for our nomenclators at home.

Those who usually bring these birds over are content to make three or four distinctions, to which they give names; and with these distinctions I will content myself also. The large kind, which are of the size of a raven, are called *maccaws;* the next size are simply called *parrots;* those which are entirely white, are called *lories;* and the lesser size of all are called *parrakeets.* The difference between even these is rather in size than any other peculiar conformation, as they are all formed alike, having toes, two before and two behind, for climbing and holding; strong hooked bills for breaking open nuts, and other hard substances, on which they feed; and loud harsh voices, by which they fill their native woods with clamour.

But there are further peculiarities in their conformation; and first, their toes are contrived in a singular manner, which appears when they walk or climb, and when they are eating. For the first purpose they stretch two of their toes forward, and two backward; but when they take their meat, and bring it to their mouths with their foot, they dexterously and nimbly turn the greater hind toe forward, so as to take a firmer grasp of the nut or the fruit they are going to feed on, standing all the while upon the other leg. Nor even do they present their food in the usual manner; for other animals turn their meat inwards to the mouth; but these, in a seemingly awkward position, turn their meat outwards, and thus hold the hardest nuts, as if in one hand, till with their bills they break the shell, and extract the kernel.

The bill is fashioned with still greater peculiarities; for the upper chap, as well as the lower, are both movable. In most other birds the upper chap is connected, and makes but one piece with the skull; but in these, and in one or two species of the feathered

[1] The parrot genus includes about one hundred and seventy known species. All the species are confined to warm climates, but their range is wider than Buffon considered, when he limited them to within 23° on each side of the equator; for they are known to extend as far south as the Straits of Magellan, and are found on the shores of Van Dieman's Land; and the Carolina parrot of the United States is resident as far to the north as 42°. Wilson saw them, in the month of February, along the banks of the Ohio, in a snow-storm, flying about like pigeons, and in full cry. And another time he saw them, about thirty miles above the mouth of the Kentucky river, as they came in great numbers, screaming through the wood, about an hour after sunrise, to drink the salt water, of which they are remarkably fond.

Parrots live together in families, and seldom wander to any considerable distance; these societies admit with difficulty a stranger among them, though they live in great harmony with each other. They are fond of scratching each other's heads and necks; and, when they roost, nestle as closely as possible together, sometimes as many as thirty or forty sleeping in the hollow of the same tree. There they sleep in a perpendicular posture, clinging to the sides by their claws and bills. They are fond of sleep, and seem to retire into their holes several times in the day as if to enjoy a regular *siesta.*

The young shoots of various plants, tender buds, fruits, grains, and nuts, which they open with much adroitness to obtain the kernel, are the chief aliments which the parrots use when in a state of liberty. We know that, in a state of domestication, they eat almost everything that is offered to them; but it has been remarked that certain substances, such as parsley for instance, which have no sensible effect on other creatures, are to parrots mortal poisons. In the forests, which are their favourite retreats, the parrots assemble in troops, and cause much devastation by the vast quantity of food which they consume, not merely for their subsistence, but to gratify that mania for destruction for which, even in their domestic state, they are noted. The loud cries of these bands are heard a great way off, when they seek their last repast before the setting of the sun. By these cries the planter has timely warning to employ some means of preventing those hosts of destroyers from alighting on his newly-sown fields, where, in a short time, they would not leave a vestige of grain.

The description which Wilson gives of the flight of the Carolina parrot is probably applicable to many other species which have not, in their wild state, been noticed by an equally intelligent observer. "There is a remarkable contrast between their elegant manner of flight and their lame and crawling gait among the branches. They fly very much like the wild pigeon, in close compact bodies, and with great rapidity, making a loud and outrageous screaming. Their flight is sometimes in a direct line, but most usually circuitous, making a great variety of elegant and serpentine meanders, as if for pleasure."

The Carolina parrot seems to have been a favourite with Wilson. He carried one with him in one of his most laborious journeys in the Western States; by day it rode in his pocket, and at night it rested on the baggage, dosing and gazing into the fire. Happening to catch another, which he had slightly wounded, he placed it in the cage with this, who was delighted to gain the accession to her society; she crept up to the stranger, chattering in a melancholy tone, as if expressing sympathy for its misfortunes, stroked its head and neck with her bill, and at night they nestled as close as possible to each other. On the death of her companion, she appeared inconsolable, till he placed a looking-glass near her, by which she was completely deceived. She seemed delighted with the return of her companion, and often during the day, and always at night, she lay close to the image in the glass, and began to dose with great composure and satisfaction. He was so unlucky as to lose this interesting bird in the Gulf of Mexico, where she made her way through the cage, left the vessel, and perished in the waves.

tribe more, the upper chap is connected to the bone of the head by a strong membrane, placed on each side, that lifts and depresses it at pleasure. By this contrivance they can open their bills the wider; which is not a little useful, as the upper chap is so hooked and so over-hanging, that, if the lower chap only had motion, they could scarcely gape sufficiently to take any thing in for their nourishment.

Such are the uses of the beak and the toes, when used separately; but they are often employed both together, when the bird is exercised in climbing. As these birds cannot readily hop from bough to bough, their legs not being adapted for that purpose, they use both the beak and the feet; first catching hold with the beak, as if with a hook, then drawing up the legs and fastening them, then advancing the head and beak again, and so putting forward the body and feet alternately, till they attain the height they aspire to.

The tongue of this bird somewhat resembles that of a man; for which reason some pretend that it is so well qualified to imitate the human speech; but the organs by which these sounds are articulated lie farther down in the throat, being performed by the great motion which the *os hyoides* has in these birds above others.

The parrot, though common enough in Europe, will not, however, breed here. The climate is too cold for its warm constitution; and though it bears our winter when arrived at maturity, yet it always seems sensible of its rigour, and loses both its spirit and appetite during the colder part of the season. It then becomes torpid and inactive, and seems quite changed from that bustling loquacious animal which it appeared in its native forest, where it is almost ever upon the wing. Notwithstanding, the parrot lives even with us a considerable time, if it be properly attended to; and indeed, it must be owned, that it employs but too great a part of some people's attention.

The extreme sagacity and docility of the bird may plead as the best excuse for those who spend whole hours in teaching their parrots to speak; and, indeed, the bird, on those occasions, seems the wisest animal of the two. It at first obstinately resists all instruction; but seems to be won by perseverance, makes a few attempts to imitate the first sounds, and when it has got one word distinct, all the succeeding come with greater facility. The bird generally learns most in those families where the master or mistress have the least to do; and becomes more expert, in proportion as its instructors are idly assiduous. In going through the towns of France some time since, I could not help observing how much plainer their parrots spoke than ours, and how very distinctly I understood their parrots speak French, when I could not understand our own, though they spoke my native language. I was at first for ascribing it to the different qualities of the two languages, and was for entering into an elaborate discussion on the vowels and consonants: but a friend that was with me solved the difficulty at once, by assuring me that the French women scarcely did any thing else the whole day than sit and instruct their feathered pupils; and that the birds were thus distinct in their lessons in consequence of continual schooling.

The parrots of France are certainly very expert, but nothing to those of the Brazils, where the education of a parrot is considered as a very serious affair. The history of Prince Maurice's parrot, given us by Mr Locke, is too well known to be repeated here; but Clusius assures us that the parrots of that country are the most sensible and cunning of all animals not endued with reason. The great parrot, called the *aicurous*, the head of which is adorned with yellow, red, and violet, the body green, the ends of the wings red, the feathers of the tail long and yellow; this bird, he asserts, which is seldom brought into Europe, is a prodigy of understanding. "A certain Brazilian woman, that lived in a village two miles distant from the island on which we resided, had a parrot of this kind which was the wonder of the place. It seemed endued with such understanding as to discern and comprehend whatever she said to it. As we sometimes used to pass by that woman's house, she used to call upon us to stop, promising, if we gave her a comb, or a looking-glass, that she would make her parrot sing and dance to entertain us. If we agreed to her request, as soon as she had pronounced some words to the bird, it began not only to leap and skip on the perch on which it stood, but also to talk and to whistle, and imitate the shoutings and exclamations of the Brazilians when they prepare for battle. In brief, when it came into the woman's head to bid it sing, it sang; to dance, it danced. But if, contrary to our promise, we refused to give the woman the little present agreed on, the parrot seemed to sympathize in her resentment, and was silent and immovable; neither could we, by any means, provoke it to move either foot or tongue."

This sagacity, which parrots show in a domestic state, seems also natural to them in their native residence among the woods. They live together in flocks, and naturally assist each other against other animals, either by their courage or their notes of warning. They generally breed in hollow trees, where they make a round hole, and do not line their nests within. If they find any part of a tree be-

ginning to rot from the breaking off of a branch, or any such accident, this they take care to scoop, and to make the hole sufficiently wide and convenient; but it sometimes happens that they are content with the hole which a woodpecker has wrought out with greater ease before them; and in this they prepare to hatch and bring up their young.

They lay two or three eggs; and probably the smaller kind may lay more; for it is a rule that universally holds through nature, that the smallest animals are always the most prolific; for being, from their natural weakness, more subject to devastation, Nature finds it necessary to replenish the species by superior fecundity. In general, however, the number of their eggs is stinted to two, like those of the pigeon, and they are about the same size. They are always marked with little specks, like those of a partridge; and some travellers assure us, that they are always found in the trunks of the tallest, straightest, and the largest trees. The natives of those countries, who have little else to do, are very assiduous in spying out the places where the parrot is seen to nestle, and generally come with great joy to inform the Europeans, if there be any, of the discovery. As those birds have always the greatest docility that are taken young, such a nest is often considered as worth taking some trouble to be possessed of; and, for this purpose, the usual method of coming at the young is, by cutting down the tree. In the fall of the tree it often happens that the young parrots are killed; but if one of them survives the shock, it is considered as a sufficient recompence.

Such is the avidity with which these birds are sought when young; for it is known they always speak best when their ear has not been anticipated by the harsh notes of the wild ones. But as the natives are not able upon all occasions to supply the demand for young ones, they are contented to take the old; and for that purpose shoot them in the woods with heavy arrows, headed with cotton, which knock down the bird without killing it. The parrots thus stunned are carried home: some die, but others recover, and, by kind usage and plentiful food, become talkative and noisy.

But it is not for the sake of their conversation alone that the parrot is sought after among the savages; for though some of them are but tough and ill-tasted, yet there are other sorts, particularly of the small parakeet tribe, that are very delicate food. In general it obtains, that whatever fruit or grain these birds mostly feed upon, their flesh partakes of the flavour, and becomes good or ill-tasted, according to the quality of their particular diet. When the guava is ripe, they are at that season fat and tender; if they feed upon the seed of the acajou, their flesh contracts an agreeable flavour of garlic; if they feed upon the seed of the spicy trees, their flesh then tastes of cloves and cinnamon; while, on the contrary, it is insupportably bitter if the berries they feed on are of that quality. The seed of the cotton-tree intoxicates them in the same manner as wine does man; and even wine itself is drunk by parrots, as Aristotle assures us, by which they are thus rendered more talkative and amusing. But of all food, they are fondest of the carthamus, or bastard saffron; which, though strongly purgative to man, agrees perfectly with their constitution, and fattens them in a very short time.

Of the parakeet kind in Brazil, Labat assures us, that they are the most beautiful in their plumage, and the most talkative birds in nature. They are very tame, and appear fond of mankind; they seem pleased with holding parley with him; they never have done; but while he continues to talk, answer him, and appear resolved to have the last word: but they are possessed of another quality, which is sufficient to put an end to this association; their flesh is the most delicate imaginable, and highly esteemed by those who are fonder of indulging their appetites than their ears. The fowler walks into the woods, where they keep in abundance, but as they are green, and exactly the colour of the leaves among which they sit, he only hears their prattle, without being able to see a single bird; he looks round him, sensible that his game is within gun-shot in abundance, but is mortified to the last degree that it is impossible to see them. Unfortunately for these little animals, they are restless, and ever on the wing, so that in flying from one tree to another, he has but too frequent opportunities of destroying them; for as soon as they have stripped the tree on which they sat of all its berries, some one of them flies off to another; and if that be found fit for the purpose, it gives a loud call, which all the rest resort to. That is the opportunity the fowler has long been waiting for; he fires in among the flock, while they are yet on the wing; and he seldom fails of bringing down a part of them. But it is singular enough to see them when they find their companions fallen. They set up a loud outcry, as if they were chiding their destroyer, and do not cease till they see him preparing for a second charge.

But though there are so many motives for destroying these beautiful birds, they are in very great plenty; and in some countries on the coast of Guinea, they are considered by the negroes as their greatest tormentors. The flocks of parrots persecute them with their unceasing screaming, and devour whatever fruits they attempt to produce by art in their little

gardens. In other places they are not so destructive, but sufficiently common; and, indeed, there is scarce a country of the tropical climates that has not many of the common kinds, as well as some peculiarly its own. Travellers have counted more than a hundred different kinds on the continent of Africa only: there is one country in particular, north of the Cape of Good Hope, which takes its name from the multitude of parrots which are seen in its woods. There are white parrots seen in the burning regions of Ethiopia: in the East Indies they are of the largest size; in South America they are docile and talkative; in all the islands of the Pacific sea and the Indian ocean, they swarm in great variety and abundance, and add to the splendour of those woods which Nature has dressed in eternal green.[1]

So generally are these birds known at present, and so great is their variety, that nothing seems more extraordinary than that there was but one sort of them known among

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[1] The family of parrots are divided by some modern naturalists into six different groups.

I. The Macaws. Tail long and pointed; cheeks naked.

II. The Parrakeets. Tail long and graduated; cheeks feathered.

III. The Psittacules. Tail very short, and rounded at its termination; cheeks feathered.

IV. The Parrots proper. Tail equal and squared; head destitute of movable crest.

V. The Cockatoos. Tail equal and squared; head with a movable crest.

VI. Probosciger. Tail equal and squared; naked cheeks, and tuft on head.

In the cuts which follow, representations are given of some of the more interesting individuals of these different groups.

The Great Green Macaw. This species is now ascertained to be a native of Mexico and Peru, inhabiting the warmer districts of the Andean chain, which attain an elevation of about 3000 feet. According to Wagler, its habits differ considerably from those of its congeners, as it does not confine itself to the recesses of the forests, or its food to the fruits there produced, but attacks in congregated flocks the fields of maize, and other cultivated grain and fruits. Upon these it frequently commits serious depredations, to such an extent, indeed, as to require the constant attention and watching of the inhabitants during the period of maturation. When engaged in their predatory excursions, a guard is constantly left by the flock in some elevated station, generally the summit of a tree, from whence, should danger be apprehended, an alarm is given by a loud and peculiar cry, which is responded to by the immediate flight of the wary depredators. They are also said to feed upon the flowers of the Erythinæ, and some species of Thibaudæ, before the ripening of the grains, but whether this is merely to obtain the nectarious juice, as practised by the Asiatic Lories and Australian Trichoglossi, or for the thick and fleshy substance of the flower and embryo pod or seed-vessel, does not appear from Wagler's account. During the period of the rains, which commence in October, the great body of these birds migrate to other districts, and do not return till the maize begins to ripen, which takes place in January and February. It is easily tamed, and of a docile disposition, but can rarely be taught to articulate more than a few words. It appears to have been a favourite among the ancient Peruvians, as we are told it was frequently presented to the Incas, by their subjects, as an acceptable gift. In size, it is inferior to several of the Macaws, its extreme length being about twenty-nine inches. The bill is strong, typical in form, its colour blackish-brown. The orbits and cheeks are naked, and of a flesh colour, with striæ of small blackish-brown feathers; the irides are composed of two rings, the outer of a rich yellow, the inner grayish-green. The forehead is of a rich crimson, the chin feathers reddish-brown, and passing rapidly into the green of the neck. The rest of the head, the neck, lesser wing-coverts, the mantle, and all the under parts of the body, are of a fine and lively green, in some lights showing tints of azure blue on the back of the neck and head. The lower back and upper tail coverts, as well as the greater wing-coverts and quills, are of a fine blue. The tail feathers on the upper surface are scarlet, with blue tips, the under surface and that of the wings orange-yellow. The legs and toes are red, tinged with gray. The claws are strong, hooked, and black.



The Alexandrine Ring-Parakeet. This parrot is generally supposed to have been the first, and by many the only one known to the ancient Greeks, having been discovered during the expeditions of the Macedonian conqueror, by whose followers it was brought to Europe from the ancient Taprobane, now the Island of Ceylon. At all events, it is evident, from the concurrent testimony of various ancient authors, that whatever parrots were known, either to the Greeks or Romans, previous



the ancients, and that at a time when they pretended to be masters of the world. If nothing else could serve to show the vanity of a Roman's boast, the parrot-tribe might be an instance, of which there are a hundred kinds now known; not one of which naturally breeds in the countries that acknowledged the Roman power. The green parakeet, with a red neck,

to the time of Nero, were exclusively brought from India or its islands, and that the species, if more than one had been introduced, also belonged to the genus now under consideration, the description they have given of the plumage of these birds pointing distinctly to this, and possibly one or two other nearly allied species, as not only the prevailing colour of the body, but that of the bill, and the distinguishing characteristic, the neck-collar, are particularly mentioned. The Alexandrine, as well as its congener the Rose-ring Parakeet, are still highly prized, and frequently brought from the East Indies, as, in age, they possess great docility, and a facility of pronunciation inferior to none of the race. Of their habits in a state of nature we remain comparatively ignorant.

The Ash-coloured or Grey Parrot. The Grey Par-



rot is a native of western Africa, whence it appears to have been imported from a very early period; but common and well known as it is in a state of captivity, its peculiar habits and economy in a state of nature are still but little and imperfectly known. Like most of its kind, it is said to breed in the hollows of decayed trees; and the instinctive propensity for such situations does not appear to desert it even in a state of captivity; for Buffon mentions a pair in France, that, for five or six years successively, produced and brought up their young, and the place they selected for this purpose was a cask partly filled with saw-dust. Its eggs are stated to be generally four in number, their colour white, and in size equal to those of a pigeon. In its native state, the food of the Parrot consists of the kernels of various fruits, and the seeds of other vegetables; but when domesticated, or kept caged, its principal diet is generally bread and milk, varied with nuts, almonds, &c., and even pieces of dressed meat. When feeding, it often holds its food clasped in the foot, and, before swallowing, masticates or reduces it to small pieces by its powerful bill and palatial cutters. This member, so unlike that of other frugivorous birds, is admirably calculated for the principal offices it has to perform, viz. breaking the shells of the hardest fruits and seeds, and as a strong and powerful organ of prehension and support; for few of our readers but must have observed that the bill is always first used, and chiefly depended upon when a Parrot is caged, in climbing or moving from one position to another. The longevity of the feathered race, we believe, in general far exceeds what is commonly supposed, at least if we may judge from the age attained by various birds, even when subjected to captivity and confinement. Thus, we have instances of eagles living for half a century: the same of ravens, geese, and other large birds, as well as among the smaller kinds usually kept caged. The Parrot appears to yield to none of these, and several instances are upon record of their having reached the remarkable age of sixty or seventy years. Among these, none is more interesting than that of an individual mentioned by M. Le Vaillant, which had lived in a state of domesticity for no less than ninety-three years. At the time that eminent naturalist saw it, it was in a state of entire decrepitude, and in a kind of lethargic condition, its sight and memory being both gone, and was fed at intervals with biscuit soaked in Madeira wine. In the time of its youth and vigour it had been distinguished for its colloquial powers, and distinct enunciation, and was of so docile and obedient a disposition, as to fetch its master's slippers when required, as well as to call the servants, &c. At the age of sixty, its memory began to fail, and, instead of acquiring any new phrase, it began to lose those it had before attained, and to intermix, in a discordant manner, the words of its former language. It moulted regularly every year till the age of sixty-five, when this process grew irregular, and the tail became yellow, after which, no farther change of plumage took place. The Gray Parrot is subject to variety, sometimes the ground colour being mixed with red. In size it measures about twelve inches in length. The bill is black, strong, and much hooked, and the orbits, and space between them and the eyes, covered with a naked and white skin. The whole of the plumage, with the exception of the tail, which is of a bright deep scarlet, is of an ash-gray colour, deepest upon the back, and the feathers finely relieved and margined with paler gray. The irides are of a pale yellowish-white, the feet and toes gray, tinged with flesh-red.

The Tri-coloured crested Cockatoo. This Cockatoo is



a native of Australia. The bill is of a pale grayish-white; the upper mandible strongly sinuated and toothed; the irides of a deep brown; the naked orbits whitish. The feathers at the immediate base of the bill are crimson, forming a narrow band or fillet; those of the forehead are white, tinged with red. The feathers forming the proper crest are long and acuminate, the tips bending forwards, their basal half crimson, divided by a bar of rich yellow, the remainder pure white. The whole of the body is white, tinged deeply with crimson upon the neck, breast, flanks, and under tail-coverts. The under surface of the wings is rich crimson-red. Its legs and toes are deep gray, the scales distinctly marked by lighter lines. Of its peculiar habits and economy we are unable to give any detailed account. Another Australian species is the Helmeted Cockatoo, Plyctolophus galeritus, enumerated by Mr Vigors and Dr Horsfield in their description of the Australian birds in the collection of the Linnean Society; and as its habits are presumed to resemble in many respects those of the other species, we

was the first of this kind that was brought into Europe, and the only one that was known to the ancients, from the time of Alexander the Great to the age of Nero: this was brought from India; and when afterwards the Romans began to seek and rummage through all their dominions, for new and unheard-of luxuries, they at last found out others in Gaganda, an island of Ethiopia, which they considered as an extraordinary discovery.

Parrots have usually the same disorders with other birds; and they have one or two peculiar to their kind. They are sometimes struck by a kind of apoplectic blow, by which

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quote their observations, as extracted from M. Caley's Notes. "This bird is called by the natives Car-away and Cur-iang. I have often met with it in large flocks at the influx of the Grose and the Hawkesbury rivers, below Mulgo'ey on the former river, and in the long meadow near the Nepean river. They are shy, and not easily approached. The flesh of the young ones is accounted good eating. I have heard from the natives that it makes its nest in the rotten limbs of trees, of nothing more than the vegetable mould formed by the decayed parts of the bough; that it has no more than two young ones at a time; and that the eggs are white, without spots. The natives first find where the nests are, by the bird making co'tora in an adjoining tree, which lies in conspicuous heaps on the ground. Co'tora is the bark stripped off the smaller branches, and cut into small pieces. When the young ones are nearly fledged, the old birds cut a quantity of small branches from the adjoining trees, but never from that in which the nest is situated. They are sometimes found to enter the hollow limb as far as two yards. The nests are generally found in a black-butted gum-tree, and also in Coroy'bo, Cajimbora, and Yarrowar'ry trees (species of Eucalyptus)."

Goliah Aratoo. This is one of the largest of the



Psittacules. It is a native of the eastern Australasian islands. The whole of the plumage is black. Little is known of its habits.

Purple Capped Lory. This bird is a native of the



Moluccas, and other Eastern islands, from whence we occasionally receive it, being held in high estimation, not only on account of its elegant plumage, but for the docility it evinces, and its distinct utterance of words and sentences. It is also lively and active in its disposition, and fond of being caressed. In size it is amongst the largest of the group, measuring upwards of eleven inches in length. The general or ground colour of the plumage is rich scarlet, this tint occupying all the lower parts of the body, with the exception of a collar of yellow upon the upper part of the breast. The neck, back, upper tail-coverts, and basal part of the tail, are also of the same colour. The crown of the head is blackish-purple in front, passing into violet-purple on the hinder part. The wings on the upper surface are green, the flexure and margins violet blue, as are also the under wing-coverts. The feathers of the thighs are azure-coloured exteriorly, their basal parts being greenish. The bill is orange yellow; the under mandible conic, and narrow towards the tip.

Blue-bellied Lorikeet. This species is a native of



New Holland, where it is found in large flocks, wherever the various species of Eucalypti abound, the flowers of those trees affording an abundant supply of food to this as well as to other species of the Nectivorous Parrots. According to the observations of Mr Caley, as quoted by Messrs Vigors and Horsfield in their description of the Australian birds in the collection of the Linnæan Society, "Flocks of these birds may be seen in the eucalypti-trees, when in flower, in different parts of the country, but in the greatest number near their breeding places." They do not, he adds, eat any kind of grain, even in a domesticated state; a fact curiously illustrative of their peculiar habits, and the situation they hold in the family of the Psittacules. It appears that they seldom live long in confinement, and that when caged they are very subject to fits. This in all probability arises from a deficiency of their natural food; and the instinctive feeling or appetite for its favourite diet is strongly exemplified in the fact, that one kept by Mr Caley being shown a figure of a coloured plant, used to put its tongue to the flowers, as if with the intent of sucking them, and this it even did when shown a figured piece of cotton furniture. By the natives it is called Warrin; the settlers call it by the name of the Blue Mountain Parrot, though the term seems to be misapplied, as it is a frequenter of the plains, and not of the hilly districts. Its flesh is excellent, and highly esteemed.

The Ground Parrot. The Ground Parrot is also a native of New Holland and Van Dieman's Land, where it inhabits the scrubs or ground partially covered with

they fall from their perches, and for a while seem ready to expire.[1] The other is the growing of the beak, which becomes so very much hooked as to deprive them of the power of eating. These infirmities, however, do not hinder them from being long-lived; for a parrot, well kept, will live five or six and twenty years.

CHAP. VIII.

THE PIGEON, AND ITS VARIETIES.[2]

This is one of the birds which, from its great fecundity, we have, in some measure, reclaimed from a state of nature, and taught to live in habits of dependence. Indeed, its fecundity seems to be increased by human cultivation; since those pigeons that live in a

low underwood. It is very rarely seen perched, and when flushed, Mr Caley observes, takes a short flight,



and then alights among the bushes, but never upon them. Of its mode of nidification, and other matters connected with its history, we are unable to give any further account. (For the materials of this note we are mainly indebted to a volume on Parrots, by Mr Selby, in the Naturalist's Library.)

[1] Bleeding in the foot is recommended as a remedy for this.

[2] The birds of this genus, which contains more than one hundred species, inhabit all the warm and temperate regions of the globe. The species with short and robust bill are found throughout the whole extent of Africa, in the islands of the Indian archipelago, in New Holland, and in the islands of the South sea. The common pigeons, with moderate bill, are the most generally extended through both continents. Those with slender bill and long legs are proper to the climates of the new world, of Africa, and of Asia, but are not found in Europe. Only four species of the common pigeons are found wild in this last part of the globe; from one of them, the biset or wild rock pigeon, as is supposed, are descended all the various races which we find in a state of domestication. Whether under the name of pigeons or doves, these birds are uniformly quiet and harmless in their nature. They live almost exclusively on fruits, berries, seeds, and grains, and very seldom consume insects or snails, or other animal food. In their mode of living together, they are understood to be strict monogamists, each attaching itself to a single mate, and adhering to it alone; but to this there are exceptions, as we happen to have witnessed amongst the domesticated species, in all of whom the bond of attachment is very slight. The female seldom lays more than two eggs, and it is remarkable that they almost invariably produce a male and a female. Nature has assigned to pigeons an important office in the economy of creation. Their stomachs do not digest the seeds of certain fruits, and these seeds being voided in the course of the animal's flight, trees are thus disseminated and planted in situations which could never otherwise be reached by the parent vegetables. The power of flight which pigeons generally possess, seems to be only a feature in the animal's character subordinate to this beautiful and providential design.

With a general resemblance of character, pigeons differ very materially in external appearance, both in respect of shape and colour of plumage. In all countries of the temperate zones they resemble the common house pigeons of Britain, and are of a grayish or bluish tinge of feather. In the warm countries within the tropics, they shine forth with all the brilliancy of plumage of parrots and other gay-feathered animals. The *vinago aromatico*, (see Plate XV. fig. 29.) as one of the Indian varieties of pigeons is called, is a beautiful creature with bright light-green feathers from the breast to the tail, with a darkish-coloured back, and wings striped with yellow and brown. The *ptilinopus purpuratus*, a variety found in India and Australia, is still more of a bright green all over, here and there patched with bits of a golden hue, and having a light purple crest. Green, light blue, white, and cream colour, seem to be the predominating tints of the other varieties. The *turtur risorius*, which is the pigeon referred to in the scriptures, under the name of the turtle dove, is of a cream colour, lighter on the breast than on the back, with a stripe of green round the neck, and eyes of a red hue. The most beautiful and handsome shaped pigeon is the *turtur lophotes*, a native of Australia. This elegant bird is of a very light gray colour on the head and breast, brown along the back, wings with green, red, brown, and cream-coloured feathers, and tail black, except round the edges, which are white; from the back of the head grows a long slender tuft pointed gracefully upward, and giving the animal an appearance somewhat like the tufted cockatoo.

The American continent is famed for the prodigious number of its pigeons, the vast extent of forest affording them at once a place of safe resort and an abundance of food for their subsistence. Audubon describes the habits and geographical distribution of six varieties of pigeons which frequent the United States: the Passenger pigeon, the Carolina dove, the Ground dove, the White-headed pigeon, the Zenaida dove, and the Key West pigeon.

The *Passenger pigeon* possesses, as is well known, an



extraordinary power of flight, and this is seconded by as great a power of vision. Though flying high and swiftly,

wild state, in the woods, are by no means so fruitful as those in our pigeon-houses nearer home. The power of increase in most birds depends upon the quantity of their food; and it is seen, in more than one instance, that man, by supplying food in plenty, and allowing the animal at the same time a proper share of freedom, has brought some of those kinds which are known to lay but once a year, to become much more prolific.

The tame pigeon, and all its beautiful varieties, derive their orgin from one species, the stock-dove only; the English name, implying its being the stock or stem from whence the other domestic kinds have been propagated.[1] This bird, in its natural state, is of a deep bluish ash-colour; the breast dashed with a fine changeable green and purple; its wings marked with two black bars; the back white, and the tail barred near the end with black. These are the colours of the pigeon in a state of nature; and from these simple tints has man by art propagated a variety that words cannot describe, nor even fancy suggest. How-

they can inspect the country below them with facility, and easily perceive the food they are in quest of. In Ohio, Kentucky, and Indiana, the largest flocks of these wild pigeons are seen. Wilson's description of the myriad flocks of these pigeons has often been quoted. His successor, Audubon, in a paper read before the Royal Society of Edinburgh, gives the following description of them.

The most important facts, he says, connected with the habits of these birds relate to their extraordinary associations and migrations. No other species known to naturalists is more calculated to attract the attention of either the citizen or the stranger, as he has opportunities of viewing both of these characteristic habits while they are passing from north to south, east and west, and *vice versa*, over and across the whole extent of the United States of America.

Their great power of flight enables them when in need, to survey and pass over an astonishing extent of country in a very short time. This is proved by facts known to the greater number of observers in America. Pigeons, for example, have been killed in the neighbourhood of New York, with their crops still filled with rice, collected by them in the fields of Georgia and Carolina, the nearest point at which this supply could possibly have been obtained; and as it is well ascertained that, owing to their great power of digestion, they will decompose food entirely in twelve hours, they must have travelled between three hundred and four hundred miles in six hours, making their speed at an average of about one mile in a minute, and this would enable one of these birds, if so inclined, to visit the European continent, as swallows undoubtedly are able to do, in a couple of days.

Their multitudes in our woods are astonishing; and, indeed, after having viewed them so often, and under so many circumstances, for years, and, I may add, in many different climates, I even now feel inclined to pause, and assure myself afresh that what I am going to relate is fact. That I have seen it is most certain; and I have seen it all in the company of hundreds of other persons looking on, like myself, amazed, and wondering if what we saw was really true.

In the autumn of 1813, I left my house at Henderson, on the banks of the Ohio, on my way to Louisville. Having met the pigeons flying from north-east to south-west, in the barrens or natural wastes a few miles beyond Hardensburgh, in greater apparent numbers than I thought I had ever seen them before, I felt an inclination to enumerate the flocks that would pass within the reach of my eye in one hour. I dismounted, and, seating myself on a tolerable eminence, took my pencil to mark down what I saw going by and over me, and made a dot for every flock which passed. Finding, however, that this was next to impossible, and feeling unable to record the flocks, as they multiplied constantly, I rose, and counting the dots then put down, discovered that a hundred and sixty-three had been made in twenty-one minutes. I travelled on, and still met more the farther I went. The air was literally filled with pigeons; the light of noon-day became dim, as during an eclipse; the pigeons' dung fell in spots, not unlike melting flakes of snow; and the continued buzz of their wings over me had a tendency to incline my senses to repose. Whilst waiting for my dinner at Young's Inn, at the confluence of Salt river with the Ohio, I saw, at my leisure, immense legions still going by, with a front reaching far beyond the Ohio on the west, and the beech wood forests directly on the east of me. Yet not a single bird would alight; for not a nut or acorn was that year to be seen in the neighbourhood. They consequently flew so high, that different trials to reach them with a capital rifle proved ineffectual, and not even the report disturbed them in the least. But I cannot describe how beautiful their aërial evolutions were if a black hawk appeared in their rear. At once, like a torrent, and with a thunder-like noise, they formed themselves into almost a solid compact mass, pressing each on each towards the centre; and when in such solid bodies they zig-zagged to escape the murderous falcon, now down close over the earth, sweeping with inconceivable velocity, then ascending perpendicularly, like a vast monument; and when high were seen wheeling and twisting within their continued lines, resembling the coils of a gigantic serpent. Before sunset I reached Louisville, distance from Hardensburgh fifty-five miles, where the pigeons were still passing; and this continued for three days in succession. The people were indeed all up in arms, and shooting on all sides at the passing flocks. The banks of the river were crowded with men and children, for here the pigeons flew rather low as they passed the Ohio. This gave a fair opportunity to destroy them in great number. For a week or more the population spoke of nothing but pigeons, and fed on no other flesh but that of pigeons. The whole atmosphere during this time was strongly impregnated with the smell appertaining to their species.

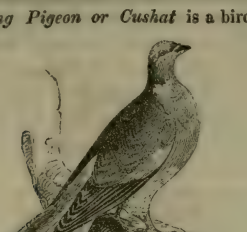
It may not, perhaps, be out of place to attempt an estimate of the number of pigeons contained in one of those mighty flocks, and the quantity of food daily consumed by its members. The inquiry will show the astonishing bounty of the Creator in his works, and how universally this bounty has been granted to every living thing on that vast continent of America.

We shall take, for example, a column of one mile in breadth, which is far below the average size, and suppose it passing over us without interruption for three hours, at the rate mentioned above, of one mile per minute. This will give us a parallelogram of one hundred and eighty miles by one, covering one hundred and eighty square miles, and allowing two pigeons to the square yard, we have one billion one hundred and fifteen millions one hundred and thirty-six thousand pigeons in one flock; and as every pigeon consumes fully half a pint of food per day, the quantity must be eight millions seven hundred and twelve thousand bushels per day which is required to feed such a flock.

[1] The British domestic pigeons are now supposed to have their origin in the wild rock-pigeon. See Note, *ante*.

ever, Nature still perseveres in her great outline; and though the form, colour, and even the fecundity, of these birds, may be altered by art, yet their natural manners and inclinations continue still the same.[1]

[1] *The Ring Pigeon or Cushat* is a bird widely dis-



seminated throughout Europe, either as a permanent resident, or as a periodical visitant; in the first state, in all those countries where the climate and temperature are such as to ensure a constant supply of food, and in the latter, in those higher latitudes where the rigour of winter is severely felt, and the ground for a long period remains covered with snow. Of its geographical distribution in other quarters of the globe, we can only speak with uncertainty, as it is evident, that species, bearing a resemblance in form and colour, have been mistaken for it, and as such recorded in the relations of various travellers. Temminck mentions it in his History of the pigeons, as inhabiting parts of northern Asia and Africa, and it is known to be a native of Madeira, as well as another nearly allied species, lately described in the "Illustrations of Ornithology," under the title of the Columba Trocaz. In America it has not yet been recognized, neither does it appear among the species which abound within the tropical latitudes of the ancient world. In Britain it is distributed from one extremity of the kingdom to the other, residing permanently with us; for, though subject to a partial movement upon the approach of winter, when the various individuals scattered over the country collect together, and form extensive flocks, no actual migration takes place, but these congregated masses still keep within their respective districts. The magnitude of these winter flocks has no doubt suggested the idea, that a migration from distant climes to this country annually takes place at this season of the year, and that the numbers of our native stock are thus augmented. We see no necessity, however, for supposing this to be the case, nor is it authorised by any observed or established fact. The species in districts favourable to its increase appears to be sufficiently numerous to account for the largest bodies ever seen assembled together.

This congregating of the Ring pigeons takes place towards the end of October or beginning of November, at which time all the autumnal broods have become fully fledged, and they remain thus united till the beginning of February, when the first mild days and the genial influence of the ascending sun again call forth those instinctive feelings which urge them to separate and pair, and each to seek an appropriate retreat for the rearing of a future brood. At first when thus congregated, they haunt the stubbles, or, in districts producing an abundance of beech-mast or acorns, the woods and trees; but as these resources become exhausted, they resort to the turnip fields, the leaves and tops of which root they greedily devour. This food now constitutes their principal support during the winter and early spring months, or until the clover begins to sprout, and the seed-corn is committed to the earth, and it has been observed that the

The stock-dove, in its native woods, differs from the ring-dove, a bird that has never been reclaimed, by its breeding in the holes of rocks and the hollows of trees. All other birds of the pigeon kind build, like rooks, in the top-

increase of the species has been progressive with that of the culture of this valuable root. The numerous and extensive plantations that of late years have been so generally made throughout the island, and which, in a young and close growing state, are peculiarly favourable to its habits, must also be taken into account, and perhaps these tend, in an equal degree to the cause above assigned, to the rapid increase of its numbers. When thus united, they repair to their feeding-ground early in the morning, and again in the afternoon before they retire to roost, the middle of the day being passed in repose or digesting their first meal, upon the nearest trees. When thus perched, some are always upon the watch, and so great is their vigilance, that it is almost impossible, by any device, to get within gun-shot. In the evening they retire to the woods to roost, preferring those of the fir tribe and the ash to any other, and in those nocturnal retreats great slaughter is sometimes committed, by waiting in concealment their arrival, which regularly takes place immediately after sunset.

The first mild weather in February produces an immediate effect upon these congregated pigeons, and we may almost calculate to a day when their cooing and plaintive murmurs will again be heard in their wonted summer haunts. The flocks are now seen daily to decrease in magnitude, and in a short time every wood and copse becomes peopled with the numerous pairs of this lovely bird. The male soon after commences a flight peculiar to the season of courtship and love, this is a rising and falling in the air, by alternate movements, in which flight, and when at the greatest elevation, the upper surfaces of the wings are brought so forcibly into contract, as to be heard at a considerable distance. Nidification soon follows this well-known signal, and by the end of April the young in many instances are fully fledged, and ready to quit the nest. Few, however, of the early brood, comparatively speaking, attain maturity, as the eggs at this season, from the naked state of the woods, are easily discovered by the prying eye and inquisitive habits of the cunning magpie and predacious carrion-crow.

The nest of the cushat is a flimsy fabric, being a mere platform of twigs loosely interwoven, so open, indeed, that the eggs, in one newly built, and before it becomes thickened by the droppings of a previous brood, may be seen through it from beneath; and so slight is the central depression, that it frequently happens, where the incubating bird is suddenly disturbed, the eggs, in the hurry to escape, are tumbled from the nest, and perish upon the ground. The site selected for nidification is various, and no tree or bush seems to come amiss at certain periods of the year. In early spring, however, and before the deciduous trees acquire their umbrageous and leafy covering, firs, and other evergreens, are preferred, on account of the better concealment and protection they afford. From this diversity of site, the nest is necessarily placed at various elevations, at one time being far removed from the ground, as when it is built near the summit of a lofty spruce, or in the thick foliage of a beech or sycamore, at another scarcely out of reach, and but a few feet from the earth, as we find it in the holly, the young fir, the thorn, or other bushy trees. The eggs, always two in number, are white, of an oblong form, and rounded nearly equally at both ends. Incubation lasts from eighteen to twenty days, and both sexes sit alternately, the male taking the place of his mate when hunger compels her to quit the nest, and so *vice*

most branches of the forest, and choose their habitation as remote as possible from man. But this species soon takes to build in artificial cavities; and, from the temptation of a ready provision and numerous society, easily submits to the tyranny of man. Still, however, it preserves its native colour for several generations, and becomes more variegated only in

versa. When first excluded, the young are blind, their skin of a blue or livid colour, thinly covered with a harsh yellow down. In this tender state they are long and assiduously brooded over by the parent birds, and are fed with a milky pulp, ejected from the crop, where the food undergoes a partial digestion, preparatory to its being given to them. As they gain strength and become fledged, food is more frequently supplied, and, consequently, from its not remaining so long in the craw of the old bird, in a less and less comminuted form, till at length, previous to their finally quitting the nest, it is administered in a state but little altered from that in which it is first swallowed by the old birds.

The Ring Pigeon breeds twice in the year, viz. in spring, and again in autumn, a cessation taking place during the greater part of June and July, being a period of comparative scarcity, the seeds of such plants as they principally subsist on not having then ripened or attained perfection. The autumnal brood, on account of the more effectual concealment of the nests by the now matured and thick foliage of the woods, is always more abundant than that of spring, and, in favourable districts, great numbers annually escape. In certain seasons, the young produce in autumn are subject to a peculiar disease, which destroys many of them even after they have quitted the nest. It appears in the form of large swellings or impostumes, upon the feet and head, which, rapidly increasing, at length deprives them of sight and the power of perching, and they perish upon the ground, emaciated by hunger and disease. This complaint, for many years past, has been observed in the northern districts of the kingdom, but whether it prevails to an equal extent in other parts, we have had no opportunity of ascertaining. The flesh of both young and old is of good flavour, that of the latter being little inferior to the moor-game or grouse, which it is thought by many to resemble in taste. This, however, can only be said of it, so long as the bird derives its support from the stubbles, or the produce of the forest; for as soon as a deficiency of their food compels it to resort to the turnip field, the flesh becomes imbued so thoroughly with the strong flavour of the plant, as no longer to be fit for the table. Though the Ring Pigeon frequently approaches our habitations during the breeding season in search of a site for its nest, and almost seems to court the vicinity of man, it always evinces a timorous disposition, and is startled and alarmed by the slightest motion or noise. In the winter, and when congregated, it becomes still more impatient of approach, and is then one of the most wary and watchful of the feathered race.

Various attempts have been made to domesticate the Ring Pigeon, but hitherto without success, for although they may be rendered very tame when in confinement, they show no disposition to breed even by themselves, much less with the common pigeon, and upon being set at liberty, soon lose any little attachment they may have shown to the place in which they were reared, and betake themselves to their natural haunts to return no more.

The Wood Pigeon till of late years, by most of our writers, was confounded with the rock pigeon, the original stock of our common pigeon, or at least had its history so mixed up with the descriptions of that bird, as to render its individuality and specific distinction a matter of considerable doubt. Brisson appears to have been the first who accurately pointed out the distinctions between the two, and he has since been followed by Temminck, who, in his general history of the pigeons, and his excellent and useful Manual of Ornithology, had so clearly marked its distinctive characters, and described its habits, as to render it almost impossible

even for a very tyro to confound or mistake the one with the other



Like the previously described species, it is indigenous, but its distribution is much more limited in extent, being confined to the southern and midland counties of England, and to such districts only as are well clothed with wood; for, possessing arboreal habits, it is never found inhabiting those localities affected by the Columba livia (rock pigeon,) such as the caverns of rocks, ruinous edifices, &c. During the spring and summer, it is distributed in pairs throughout the woods, where it breeds, sometimes in the decayed hollows of the ivy-mantled trunks, at others on the forks or amidst the higher branches of the trees. The nest is similar to that of the ring pigeon, and its two white eggs, though inferior in size, present the same oblong form. Two broods are annually produced, the first in spring, the second after midsummer, a period of rest or recruiting of the vital forces taking place between the end of May and the middle of July. As autumn advances, the various broods begin to congregate, and soon form flocks of great magnitude, which continue assembled during the winter, and are sometimes seen commingled with bodies of their larger congener, the cushat. In parts of France, Germany, and the northern kingdoms of Europe, it is a migratory species, and a summer or polar visitant, the late autumnal and winter months being passed in warmer latitudes, where a due supply of food can then be found. In disposition it shows a timidity and watchfulness equal to that of any other species, particularly during the winter months, when associated in troops. Its food consists of grain of all kinds, pulse, acorns, beechmast, &c., and like the cushat, when pressed by hunger, it frequently resorts to the turnip fields to devour the tender leaves and tops of that plant. Its flesh by Temminck is said to be of exquisite flavour, and far superior to that of the ring pigeon, but this perhaps may only be at certain periods, and when feeding upon some peculiar food.

Near as it approaches the common pigeon in size and form, no mixed breed that we are aware of has ever been obtained between them, although repeated attempts to effect an intercourse have been made. This in our mind appears a strong and convincing proof, that all the varieties, generally known by the name of Fancy Pigeons, have originated from one and the same stock, and not from crosses with other species, as some have supposed, the produce of which, even could it be occasionally obtained we have no doubt would prove to be barren, or what are generally termed mules.

The Biset or Wild Rock-Pigeon. Rocky and precipitous cliffs, particularly those of the sea-coast perforated by caverns, either originating in the nature of the rock itself, or worn and hollowed out by the action of the waves, are the appropriate retreats of the pigeon in its wild or natural state. In this condition it possesses a very extensive geographical distribution throughout the maritime dis-

proportion as it removes from the original simplicity of its colouring in the wood.

The dove-house pigeon, as is well known, breeds every month; but then it is necessary to supply it with food when the weather is severe, or the fields are covered with snow. Upon other occasions, it may be left to provide for itself, and it generally repays the owner

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tricts of the world, being abundant in most of the Rocky islands belonging to Africa and Asia, and in those of the Mediterranean, where it swarms in incredible numbers.



Upon our own coasts it is found wherever the nature of the barrier suits its habits, extending as far as the Orkneys, where Low describes it as the inhabitant of all their numerous and extensive caves, retiring to their inmost recesses, and generally beyond the situations selected for nidification by the auks, gulls, and other aquatic fowl. It is also met with upon the northern and western coasts of Sutherland, the perforated and cavernous rocks which gird the eastern side of Loch Eriboll, and those of the limestone districts of Durness, furnishing suitable places of retreat, and again upon the eastern coasts of Scotland, it is seen about the rocky steeps of the Isle of Bass, and the bold promontory of St Abb's Head.

The supposition of many of our ornithologists that this and the preceding species were identical, has led to considerable confusion in their writings, and produced a mixed sort of description strictly applicable to neither. The distinctions, however, between the species, even in regard to plumage, are such, that, if attended to, no mistake can well arise, and if accompanied by a corresponding attention to their respective habits, the difference becomes still more apparent and convincing. In one we have a bird the frequenter and inhabitant of the woods, where it roosts, breeds, and perches with security and ease upon the trees, like the ring pigeon and other arboreal species; in the other, an inhabitant of caves and the holes of rocks, and which is never known, under any circumstance, to affect the forest or perch upon a tree.

But the rock or wild pigeon is better known to our readers as the inhabitant of the pigeon-house, or, as it is frequently called, the dove-cot, buildings erected expressly for the purpose of containing colonies of these birds. In this state, where they enjoy a perfect freedom of action, and are nearly dependent upon their own exertions for support, they can scarcely be called reclaimed, much less domesticated. Man, indeed, has only taken advantage of certain habits natural to the species, and by the substitution of an artificial for a real cavern, to which the pigeon-house may be compared, has, without violating or at least greatly infringing upon its natural condition, brought it into a kind of voluntary subjection, and rendered it subservient to his benefit and use. Vast numbers of young pigeons in various parts of the world are by this system annually produced and rendered available as a wholesome and nutritious food, as well as a source of considerable profit to the proprietors of these edifices.

Various practical treatises upon the management of the dove-cot, and other details connected with it, are already before the public, and to them we must refer our readers for further information, as the limited nature of the present work will not admit of such copious extracts as would be necessary to embrace all the respective details. It may not, however, be out of place to advert to a few of the principal objects to be considered, by those who contemplate the erection of a pigeon-house; and first in regard to the form of the building. The most approved is that of a circular tower, as it affords advantages not possessed by the square, giving an easier access to the breeding birds to their nests, and a greater facility of taking the young, and inspecting and clearing out the holes, by means of a ladder turning upon an axis. Around the interior of the tower, about three or four feet from the bottom, a horizontal ledge of eight or ten inches in width ought to project, in order to prevent rats, weasels, and other vermin, destructive to the eggs and young, from scaling the walls and entering the pigeon-holes, and if this ledge be covered on its under surface with tin or sheet-iron, it will the more effectually prevent the entrance of such intruders. A second ledge of less width, and about midway up in a pigeon-house of considerable height, may also be of advantage, not only for additional security against enemies, but as a resting-place for the pigeons when they enter the house. The holes or nests are best built in quincunx order, and not directly over one another, and they ought to be sufficiently large to allow the old birds to move in them with freedom, and to stand upright, in which position they always feed their young.

Frequent attention to the state of the holes is necessary, and they ought regularly to be inspected and cleansed after each great flight, that is, towards the end of May, and again before winter. The dung accumulated at the bottom of the house should also be removed every three or four months, as the effluvium which arises from it when in a large mass, and in a state of fermentation, is injurious to the health of the birds, and also prevents them making use of the lower tiers of nest-holes. In point of situation, a gentle acclivity, exposed to the south, and open to the rays of the sun, in which the pigeon delights to bask and repose, is the most favourable. It ought not to be too far removed from a plentiful supply of water, as the pigeon is a great and frequent drinker; neither too closely surrounded by trees, as, when near, they interfere with the free egress and ingress of the birds, and are supposed to be disagreeable to them, from the noise they make in winds and storms. The pigeon being a bird of a timid nature, and easily alarmed, the house should stand at such a distance from all the other offices, as not to be incommoded by any noise or movements about them. From a pigeon-house of tolerable dimensions, a produce of many dozens of young may annually be procured, and that for nearly eight months out of the twelve, as they are in full breeding from March till the end of May, and again from August till the close of November; and all that is required to keep up the breeding stock, is to permit a limited portion of the latter hatchings to escape.

In its natural state, the plumage of the pigeon is as follows:—Bill blackish-brown: the nostril membrane red, sprinkled, as it were, with a white powder. The irides pale reddish-orange. The head and throat are bluish-gray. The sides of the neck and upper part of the breast are dark lavender-purple, glossed with shades of green and purplish-red. The lower part of the breast and abdomen are bluish-gray. The upper mandible and

for its protection. The pigeon lays two white eggs, which most usually produce young ones of different sexes. For the laying of each egg, it is necessary to have a particular congress with the male; and the egg is usually deposited in the afternoon. When the eggs are thus laid, the female, in the space of fifteen days, not including the three days dur-

wing-coverts are blue-gray. The greater coverts and secondaries are barred with black, and form two broad and distinct bars across the closed wings. The lower part of the back is white; the rump and tail-coverts bluish-gray. The tail is of a deep gray, with a broad black bar at the end. The legs and feet are pale purplish-red. When closed, the wings reach within half an inch of the end of the tail.

It is under this species that we include not only the common pigeon, or inhabitant of the dove-cot, but all those numerous varieties, or, as they are frequently termed, races of domesticated pigeons, so highly prized, and fostered with such care and attention by the amateur breeder or pigeon fancier; for, however diversified their forms, colour, or peculiarity of habit may be, we consider them all as having originated from a few accidental varieties of the common pigeon, and not from any cross of that bird with other species, no signs or marks whatever of such being apparent in any of the numerous varieties known to us.

The Jacobine Pigeon. This curious variety, which,



as transmitting to its posterity a form precisely similar, with all the peculiar characters undiminished, comes under the designation, among pigeon fanciers, of a pure or permanent race, is distinguished by a remarkable ruff or frill of raised feathers, which, commencing behind the head, and proceeding down the neck and breast, form a kind of hood, not unlike that worn by a monk; and from its resemblance to which it has obtained its Gallic trivial name of *Nonnain capucin*. In size it is one of the smallest of the domestic pigeons, but its form is light and elegant. The bill is very short; the eyes surrounded with a moderate circle of naked red skin. The legs are unplumed. The head, the wings, and the tail, are always white. The usual colour of the hood is reddish-brown, with iridescent tints. The mantle, the wing-coverts, and the breast, are reddish-brown. It is also sometimes seen with the mantle and wing-coverts of a very deep red, spotted with black. Another variety, of a uniform pale fawn-colour, is not unfrequent; but that most highly prized is entirely of a pure and glossy white. It is a very productive species, and, having its flight considerably impeded by the size and form of its hooded pile, keeps much at home, and is well adapted for the aviary or other buildings where pigeons are kept confined.

The Collared Turtle. From a very remote period this species appears to have been domesticated, or rather kept in that state of captivity in which it is retained at the present day; for there is every reason to suppose that the turtle dove adverted to in Holy Writ may be referred to the same bird, as it is still abundant in Egypt and other parts of the East, where it is fostered and cultivated with care, and it is certain that many of the representations in the works of ancient art, where the dove figures as the emblem of tenderness and affection, or where it is depicted as the appropriate attendant of Venus, are accurate delineations of *the Collared or domestic Turtle*. This bird does not appear to be susceptible



of that attachment to its home or place of birth, for which the common or Dove-cot Pigeon is remarkable, and which peculiar quality renders that species so serviceable to man. On the contrary, like its congener the common or wild European turtle (*Turtur communis*,) it cannot be left to range at perfect liberty, without the danger of its flying away to return no more, and must therefore be kept constantly confined either in cages or in aviaries adapted for the purpose. In this state of captivity, if properly attended to, it breeds with facility, sometimes producing as many as eight broods within the year; but, being a native of warm climates, and very impatient of cold, it is seldom cultivated to the same extent in this country as it is in those where the temperature is better adapted to its constitution. The male shows great tenderness and affection to his mate, and is constantly by her side, soothing her with caresses, or paying his court by soft cooing notes, and that peculiar cry so expressive of laughter, and from which it takes its specific name. In its wild or natural state, it is found in various parts of Africa, and we have by us specimens from the southern part of that continent, a description of which, as varying in depth and intensity of colour from the domestic variety, is here subjoined. The length is about ten inches. The chin is whitish; from the corners of the mouth to the eyes, is a narrow streak of black. The forehead is pale bluish-gray; the crown darker; the cheeks, neck, breast, and belly gray, tinged with vinaceous or pale purplish-red; the hind neck with a demi-collar of black, some of the side feathers composing it being tipped with white. The back scapulars and rump are of a pale clove-brown, with a greenish tinge. The margins of the wings, the greater coverts, and other wing-coverts, are blue-gray. The greater quills are hair-brown, delicately edged with grayish-white. The tail is slightly rounded, the two middle feathers entirely clove-brown, the remainder on each side with the basal half black, the tips bluish-gray, except those of the two outermost, which are white. The vent and under tail-coverts are white; the legs and feet gray; the inner toe a little longer than the outer. In its natural state, it inhabits the woods, where it breeds, making a nest similar to that of the common turtle, and lays two white eggs. It seeks its food in the open grounds, and subsists upon grain, grass-seeds, pulse, &c. It is easily distinguished, and the place of its retreat soon discovered by its cooing-notes, one of which we have already stated to resemble the human laugh.

A mixed breed is sometimes obtained between this species and the common wild turtle, but the progeny are invariably mules, and incapable of further increase,—a fact that has been established by many careful and oft-repeated experiments, and one which affords a strong

ing which she is employed in laying, continues to hatch, relieved at intervals by the male. The turns are usually regulated with great exactness. From three or four o'clock in the evening till nine the next day, the female continues to sit; she is then relieved by the male, who takes his place from ten till three, while his mate is feeding abroad. In this manner they sit alternately till the young are excluded. If, during this term, the female delays to return at the expected time, the male follows, and drives her to the nest; and should he in his turn be dilatory, she retaliates with equal severity.

The young ones, when hatched, require no food for the three first days, only wanting to be kept warm, which is an employment the female takes entirely upon herself. During this period, she never stirs out, except for a few minutes to take a little food. From this they are fed for eight or ten days with corn or grain of different kinds, which the old ones gather in the fields, and keep treasured up in their crops, from whence they throw it up again into the mouths of their young ones, who very greedily demand it.

As this method of feeding the young from the crop is different in birds of the pigeon-kind from all others, it demands a more detailed explanation. Of all birds, for its size, the pigeon has the largest crop, which is also made in a manner quite peculiar to the kind. In two of these that were dissected by a member of the Royal Academy of Sciences, it was found that if the anatomist blew air into the wind-pipe, it distended the crop or gullet to a prodigious size. This was the more extraordinary, as there seemed to be no communication whatever between these two receptacles; as the conduit by which we breathe, as every one knows, leads to a very different receptacle from that where we put our food. By what apertures the air blown into the lungs of the pigeon makes its way into the crop, is unknown; but nothing is more certain than that these birds have a power of filling the crop with air; and some of them, which are called *croppers*, distend it in such a manner, that the bird's breast seems bigger than its body. The peculiar mechanism of this part is not well known; but the necessity for it in these animals is pretty obvious. The pigeon, as we all know, lives entirely upon grain and water: these are mixed together in the crop; and in the ordinary way are digested in proportion as the birds lays in its provision. But to feed its young, which are very voracious, it is necessary to lay in a store greater than ordinary and to give the food a kind of half maceration, to suit their tender appetites. The heat of the bird's body, assisted by air, and numerous glands separating a milky fluid, are the most necessary instruments for this operation: but, in proportion as the food macerates, it begins to swell also; and the crop must, of consequence, be considerably dilated. Still, however, the air which is contained in it gives the bird a power of contracting it at pleasure; for if it were filled with more solid substances, the bird could have no power to compress it. But this is not the case, the bird can compress its crop at pleasure; and driving out the air, can thus drive out the food also, which is forced up the gullet, like a pellet from a pop-gun. The young ones, open-mouthed, receive this tribute of affection, and are thus fed three times a-day. In feeding, the male usually supplies the young female, while the old female supplies the young of the opposite sex. The food with which they are supplied, is more macerated at the beginning; but as they grow older, the parents give it less preparation, and at last drive them out to shift for themselves. When well fed, however, the old ones do not wait for the total dismission of their young; but in the same nest are to be found young ones almost fit for flight, and eggs hatching at the same time.

The fidelity of the turtle-dove is proverbial, and makes the usual comparison of such poets as are content to repeat what others have said before them; but the pigeon of the dove-house is not so faithful; and having been subjected to man, it puts on licentiousness

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argument against the supposition, that many of the varieties of the common pigeon, or of the domestic fowl, are the result of a mixture of different species.

The Ferruginous Ground Dove. This diminutive



species, which only measures about six inches and a quarter in length, is pretty widely distributed throughout Brazil, Paraguay, and other districts of South America. It lives in the open grounds, but generally near to the confines of woods, as it roosts and breeds upon the lower bushes or underwood, but never upon the larger trees, or far from the ground. It is generally observed in pairs, sometimes in families of four or six, but never associated in large flocks. It appears to be of a tame disposition, as it is seen constantly about the confines of the houses or in the farm-yards, and readily admits of a near approach. Wägler observes, that, in Europe, it is easily kept and propagated in the aviary. It is active upon the ground, and feeds upon the smaller cerealia, berries, &c. (For the materials of this Note, we are indebted to Mr Selby's volume on Pigeons, in the Naturalist's Library, Edinburgh, 1835.)

among its other domestic habits. Two males are often seen quarrelling for the same mistress; and when the female admits the addresses of a new gallant, her old companion seems to bear the contempt with some marks of displeasure, abstaining from her company; or if he approaches, it is only to chastise her. There have been instances when two males, being displeased with their respective mates, have thought proper to make an exchange, and have lived in great harmony with their new companions.

So great is the produce of this bird in its domestic state, that near fifteen thousand may, in the space of four years, be produced from a single pair. But the stock-dove seldom breeds above twice a year; for when the winter months come, the whole employment of the fond couple is rather for self-preservation, than transmitting a posterity. They seem, however, to have a stronger attachment to their young than those who are found to breed so often; whether it be that instinct acts more powerfully upon them in their state of nature, or that their affections are less divided by the multiplicity of claims.

It is from a species of these, therefore, that those pigeons which are called Carriers, and are used to convey letters, are produced. These are easily distinguished from all others by their eyes, which are compassed about with a broad circle of naked white skin, and by being of a dark blue or blackish colour. It is from their attachment to their native place, and particularly where they have brought up their young, that these birds are employed in several countries as the most expeditious carriers. They are first brought from the place where they were bred, and whither it is intended to send them back with information. The letter is tied under the bird's wing, and it is then let loose to return. The little animal no sooner finds itself at liberty, than its passion for its native spot directs all its motions. It is seen, upon these occasions, flying directly into the clouds to an amazing height; and then, with the greatest certainty and exactness, directing itself, by some surprising instinct, towards home, which lies sometimes at many miles distance, bringing its message to those to whom it is directed. By what marks they discover the place, by what chart they are guided in the right way, is to us utterly unknown; certain it is, that in the space of an hour and a half they perform a journey of forty miles; which is a degree of despatch three times greater than the fleetest quadruped can perform. These birds are not brought up at present with as much care as formerly, when they were sent from governors in a besieged city to generals that were coming to relieve it without; when they were sent from princes to their subjects with the tidings of some fortunate event; or from lovers to their mistresses with expressions of their passion. The only use we now see made of them is to be let fly at Tyburn, when the cart is drawn away; pretty much as when some ancient hero was to be interred, an eagle was let off from the funeral pile, to complete his apotheosis.[1]

[1] The *Carrier Pigeon* is larger than the ordinary pigeon, being fifteen inches in length from the bill to the tail, and weighing about twenty ounces. It is generally black or dun, and occasionally blue or blue piebald, and has a very large cere hanging down by the sides of its bill, like the male turkey. The species is supposed to have been indigenous to Persia, though it is now to be found in many other countries. The instinct which has rendered the carrier pigeon so serviceable, is one manifested, under various modifications, by many other animals—an instinct by which the creature, if it becomes attached to any place as a home, as a scene of habitual gratification, or as the place where it has recently brought forth young, is able to find its way thither from any distance to which it may have been removed, if no physical obstructions of an absolutely insurmountable character should intervene. Though the carrier pigeon is naturally prompted to revert to the place of its ordinary residence, man has adopted various precautionary measures in order to make its return on particular occasions more certain. A male and female are usually kept together and treated well; and one of these, when taken elsewhere, is supposed to have the greater inducement to come back. It is even considered necessary by some that the bird should have left eggs in the process of incubation, or unfledged young ones, at home, in order to make the return certain; but probably these are superfluous precautions. It is obvious that the carrier pigeon can only be put to use in conformity with some contemplated plan, for which the proper preparations have been made. It must have been taken from a place to which it is wished that it should return, and it must, at the moment when its services are wanted, be temporarily at the place from which the intelligence is to be conveyed. It is usually taken to that place hoodwinked, or in a covered basket: the instinct by which it finds its way back upon its own wings, must of course be independent of all knowledge of the intermediate localities. When the moment for employing it has arrived, the individual requiring its services writes a small billet upon thin paper, which is placed lengthwise under the wing, and fastened by a pin to one of the feathers, with some precautions to prevent the pin from pricking, and the paper from filling with air, so as to retard and weary the bird. On being released, the carrier ascends to a great height, takes one or two turns in the air, and then commences its forward career. According to one account, it can fly a thousand parasangs, or about 2700 English miles, in a day; but several experiments of recent date seem to concur in establishing forty miles in the hour, or about a thousand a-day, as the average flight. This last computation, we may remark, gives inferior results to some which have been ascertained in reference to other birds. The common swift has been known to fly sixty, and the wild duck ninety, miles in an hour. A swallow was once found to traverse twenty miles in thirteen minutes.

Allusions to carrier pigeons are very frequent in the ancient classic writers, and in the Arabic poets. Anacreon informs us that he held a correspondence with his lovely Bathillus by means of a dove. It is related by Ælian, that Taurosthenes, a victor in the Olympic games, dispatched a pigeon stained with purple, to an-

The varieties of the tame pigeon are so numerous, that it would be a vain attempt to mention them: so much is the figure and colour of this bird under human control, that pigeon-fanciers, by coupling a male and female of different sorts, can breed them, as they express it, to a feather. From hence we have the various names of *croppers, carriers, jacobines, powters, runts, turbits*: all birds that at first might have accidentally varied from the stock-dove; and then, by having these varieties still heightened by food, climate, and pairing, different species have been produced.[1] But there are many species of

nounce his triumph to his father, then residing in the island of Ægina. Pliny also narrates that a correspondence by means of pigeons was carried on, during the siege of Modena, between Decimus Brutus and Hirtius. "Of what avail," says he, "were sentinels, circumvallations, or nets obstructing the rivers, when intelligence could be conveyed by aerial messengers?" In the crusades, the practice was tried by the besieged inhabitants of Tyre, but with less success. The besiegers had observed pigeons frequently hovering over the city, and began to suspect that these birds were messengers. Having contrived to seize one, they loaded it with false intelligence, in consequence of which they obtained possession of the place. A regular system of posting by means of carrier pigeons was established in the twelfth century by the Sultan Noureddin Mahmoud. It was afterwards improved and extended, and continued till Bagdad fell into the hands of the Mongols in 1258. Sir John Mandeville, who travelled in the fourteenth century, alludes to such a system as practised by the Turkish government. It was described at a somewhat later period as being carried on by means of lofty towers, erected at the distance of about thirty miles asunder, and provided with a proper number of pigeons. Sentinels kept watch in these towers, to receive the birds, and transmit the intelligence which they had brought by others. The notice was inscribed on a thin slip of paper, enclosed in a gold box of small dimensions, and as thin as the paper itself, suspended to the neck of the bird; the hour of arrival and departure was marked at each successive tower, and, for greater security, a duplicate was always dispatched two hours after the first. No such regular system now exists in the Turkish dominions, but carrier pigeons are still much used there. In Aleppo, during the last century, carrier pigeons were in constant employment for the purpose of acquainting the merchants with the arrival of their vessels at Scandaroon. The impatience of the animal to see its young was here taken advantage of, as an additional stimulus to procure its quick return. They would travel from Alexandretta in ten hours, and from Bagdad (thirty days' journey) in two days. From Scandaroon, which was distant forty leagues, they required only from two hours and a half to four hours. An anecdote is related of an Aleppo merchant, who, having accidentally killed one of these feathered messengers, was the first to learn that a scarcity of galls prevailed in England, and, profiting by the intelligence, made a speedy transaction, by which he gained ten thousand crowns. Towards the end of the last century, the employment of pigeons from Alexandretta and Bagdad was laid aside, on account of the frequent destruction of them by the Curd robbers. The practice was more recently in vogue among the Dutch merchants, for the purpose of anticipating the ordinary means of conveyance in the receipt of stock intelligence, by which they often realised considerable sums. For this reason, there is no European country, besides Turkey, in which carrier pigeons are so numerous as in Holland and Belgium. Two inferior varieties, called the dragoon and the horseman, have also been cultivated to a considerable extent in England, but chiefly for the gratification of the national propensity to betting, or as a department of sport.

On the 11th of July 1819, a great experiment was performed with these animals between London and Antwerp. Thirty-two pigeons, with the word Antwerp marked on their wings, and which had been reared in that city, were let loose in London at seven o'clock in the morning, after having their wings countermarked with the name of the British metropolis. The same day, towards noon, one arrived at home, and obtained the first prize; a quarter of an hour after, another arrived, and gained the second prize. The following day, twelve others arrived, making fourteen in all. Of the fate of the rest no record has come under our notice. In July 1829, another experiment was made, in consequence of wagers laid at Maestricht between some merchants there, that pigeons taken to London would, when let loose, return in six hours. Forty-two pigeons were brought to London, and after being properly marked, were thrown up at twenty-six minutes past eight in the morning. If any one of the number had arrived at Maestricht within six hours, the principal wager, which was for ten thousand guilders, would have been gained; but, in consequence, it was supposed, of a heavy rain, the first did not arrive till six hours and a quarter from the time when it left London, having, nevertheless, travelled at the rate of forty-five miles an hour, assuming that the journey was performed in a straight line. The second arrived in seven hours, the third in seven hours and ten minutes, the fourth in seven hours and a half, and, in four days, more than twenty had reached Maestricht.

[1] Of the *common domesticated pigeon* there are now innumerable breeds, all less or more differing from each other, and known by the name of fancy pigeons. The eastern suburbs of London, we believe, is the chief seat of this extravagant fancy-pigeon cultivation, which has been reduced to as regular a branch of science as that of crossing the breeds of horses, sheep, or oxen. The individuals who there carry on the trade of pigeon rearing and dealing, are able, by their skill and experience, to produce an animal coloured exactly to a feather. Certain forms, qualities, and colours of birds, are accordingly esteemed, while the smallest departure from the established fashion in any of these points renders the pigeons valueless to the fancier. Inasmuch as a single streak of yellow, though only the thickness of a hair, in a certain kind of tulip, will reduce its price from twenty guineas to half-a-crown, so will a single improperly coloured feather in the tail of a particular kind of pigeon lower its value in the same proportion. The leading varieties of fancy pigeons are known by the names of the English pouter, the Dutch cropper, the horseman, the unloper, the dragoon, the tumbler, the Leghorn and Spanish runt, the trumpeter, the nun, the fan-tail, and the capuchin. The peculiarities of some of these breeds are very odd. The tumbler, for instance, derives its name from a practice of tumbling in the air while on the wing. Instead of pursuing a steady straightforward flight, it turns over, or casts somersets backward, whirling round heels over head as expertly as a first-rate rope-dancer does when he makes the back spring. The fan-tail derives its name from the circumstance of its having a remarkably broad tail, which it has the power of spreading out like the tail of a turkey-cock. The prime quality of the bird consists in its ability to make its tail touch its head, and surround it with a wide glory of feathers. If it cannot do this, it is

the wild pigeon, which, though bearing a strong affinity to the stock-dove, are, nevertheless, sufficiently different from it to deserve a distinct description.—The *ring-dove* is of this number; a good deal larger than the former; and building its nest with a few dry sticks, in the boughs of trees. This seems a bird much fonder of its native freedom than the former; and attempts have been frequently made to render it domestic; but they have hitherto proved fruitless, for though their eggs have been hatched by the tame pigeon in a dove-house, yet, as soon as they could fly, they always betook themselves to the woods where they were first produced. In the beginning of winter these assemble in great flocks in the woods, and leave off cooing; nor do they resume this note of courtship till the beginning of March, when the genial season, by supplying them with food, renews their desires.

The turtle-dove is a smaller, but a much shyer bird, than any of the former. It may easily be distinguished from the rest by the iris of the eye, which is of a fine yellow, and by a beautiful crimson circle that encompasses the eye-lids. The fidelity of these birds is noted; and a pair being put in a cage, if one dies the other will not survive it. The turtle-dove is a bird of passage, and few, or none, remain in our northern climates in winter. They fly in flocks when they come to breed here in summer, and delight in open, mountainous, sandy countries. But they build their nests in the midst of woods, and choose the most retired situations for incubation. They feed upon all sorts of grain, but are fondest of millet seed.

To this short list might be added a long catalogue of foreign pigeons, of which we know little more than the plumage and the names. Indeed, the variety of their plumage is as beautiful, as the names by which they are known are harsh and dissonant. The *ocotzimtzcan*, for instance, is one of the most splendid tenants of the Mexican forests; but few, I believe, would desire to learn the name, only to be informed that it is covered with purple, green, and yellow plumage. To describe such birds, the historian's pen is not half such a useful implement as the painter's pencil.

valueless to the fancier, no matter how excellent are its other properties. The English pouter, which is a cross between a horseman and a cropper, possesses the remarkable property of blowing out its breast or crop to such an extent that it rises to a level with its beak, and the bird appears to look over the top of an inflated bladder. This monstrosity is highly esteemed, and, according to the rules laid down by the fancy, it ought to be large and circular, rising behind the neck, so as to cover and run off at the shoulders. There is a precise point beyond which the pouting must not be carried; for if the inflation goes too far, it upsets the bird, and causes it to tumble backward; and, therefore, to bring the pouting to the utmost pitch to which equilibrium will be preserved, is reckoned a matter of first importance.

A

HISTORY OF BIRDS.

BOOK V.

OF BIRDS OF THE SPARROW KIND.

CHAP. I.

OF BIRDS OF THE SPARROW KIND.

Still descending from the larger to the smaller, we come to birds of the sparrow kind; or that class of beautiful little animals that, being less than the pigeon, go on diminishing till we arrive at the humming-bird, the smallest of the feathered creation.

The birds which compose this class chiefly live in the neighbourhood of man, and are his greatest favourites. The falcon may be more esteemed, and the turkey more useful; but these he considers as servants, not as friends; as animals reclaimed merely to supply him with some of the conveniences of life: but these little painted songsters have his affections, as well from their beauty as their melody; it is this delightful class that fill his groves with harmony, and lift his heart to sympathize with their raptures. All the other classes are either mute or screaming; it is this diminutive tribe only that have voices equal to the beauty of their figures; equally adapted to rejoice man, and delight each other.

As they are the favourites of man, so they are chiefly seen near him. All the great birds dread his vicinity, and keep to the thickest darkness of the forest, or the brow of the most craggy precipice: but these seldom resort to the thicker parts of the wood; they keep near its edges, in the neighbourhood of cultivated fields, in the hedge-rows of farm-grounds, and even in the yard, mixing with the poultry.

It must be owned, indeed, that their living near man is not a society of affection on their part, as they approach inhabited grounds merely because their chief provision is to be found there. In the depth of the desert, or the gloom of the forest, there is no grain to be picked up; none of those tender buds that are so grateful to their appetites: insects themselves, that make so great a part of their food, are not found there in abundance; their natures being unsuited to the moisture of the place. As we enter, therefore, deeper into uncultivated woods, the silence becomes more profound; every thing carries the look of awful stillness; there are none of those warblings, none of those murmurs, that awaken attention, as near the habitations of men; there is nothing of that confused buzz, formed by the united, though distant voices of quadrupeds and birds; but all is profoundly dead and solemn. Now and then, indeed, the traveller may be roused from this lethargy of life, by the voice of a heron, or the scream of an eagle; but his sweet little friends and warblers have totally forsaken him.

There is still another reason for these little birds avoiding the depths of the forests; which is, that their most formidable enemies usually reside there. The greater birds, like robbers, choose the most dreary solitudes for their retreats; and if they do not find, they make a desert all around them. The small birds fly from their tyranny, and take protection in the vicinity of man, where they know their more unmerciful foes will not venture to pursue them.

All birds, even those of passage, seem content with a certain district to provide food and centre in. The red-breast or the wren seldom leaves the field where it has been brought up, or where its young have been excluded; even though hunted it flies along the hedge, and seems fond of the place with an imprudent perseverance. The fact is, all these small birds mark out a territory to themselves, which they will permit none of their own species to remain in; they guard their domi-

nions with the most watchful resentment; and we seldom find two male tenants in the same hedge together.

Thus, though fitted by Nature for the most wandering life, these little animals do not make such distant excursions, during the season of their stay, as the stag or the leveret. Food seems to be the only object that puts them in motion, and when that is provided for them in sufficient plenty, they never wander. But as that is seldom permanent through the year, almost every bird is then obliged to change its abode. Some are called *birds of passage*, because they are obliged to take long journeys for this purpose; but, strictly speaking, almost every other kind are birds of passage, though their migration may not be to places so remote. At some particular season of the year all small birds migrate either from one country to another, or from the more inland provinces towards the shore.

There are several persons who get a livelihood by watching the seasons when our small birds begin to migrate from one country to another, and by taking them with nets in their passage. The birds are found to fly, as the bird-catchers term it, chiefly during the month of October, and part of September and November. There is also another flight in March, which is much less considerable than that in autumn. Nor is it less remarkable, that several of these species of flight-birds make their appearance in regular succession. The pippet, for instance, begins his flight every year about Michaelmas, when they are caught in greatest number. To this the wood-lark succeeds, and continues its flight till towards the middle of October; other birds follow, but are not so punctually periodical; the greenfinch does not begin till the frost obliges it to seek for a change. These birds, during those months, fly from day-break till twelve noon; and there is afterwards a small flight from two till night. Such are the seasons of the migration of the birds, which have been usually considered as stationary, and on these occasions they are caught in great abundance, as they are on their journey. But the same arts used to allure them upon other occasions would be utterly fruitless, as they avoid the nets with the most prudent circumspection. The autumnal flight probably consists of the parents conducting their new-fledged young to those places where there is sufficient provision, and a proper temperament of the air during the winter season; and their return in spring is obviously from an attachment to the place which was found so convenient before for the purposes of nestling and incubation.

Autumn is the principal season when the bird-catcher employs his art to catch these wanderers. His nets are a most ingenious piece of mechanism, being generally twelve yards and a half long, and two yards and a half wide, and so contrived as from a flat position to rise on each side, and clap over the birds that are decoyed to come between them. The birds in their passage are always observed to fly against the wind; hence there is a great contention among the bird-catchers which shall gain the wind; for example, if it is westerly, the bird-catcher who lays his nets to the east is sure of the most plentiful sport, if his call-birds are good. For this purpose he generally carries five or six linnets, two gold-finches, two green-finches, one wood-lark, one red-poll, and perhaps a bull-finch, a yellow-hammer, a tit-lark, and an aberdavine: these are placed at small distances from the nets in little cages. He has besides what he calls his *flur-birds*, which are placed upon a movable perch, which the bird-catcher can raise at pleasure by means of a string; and these he always lifts gently up and down as the wild bird approaches. But this is not enough to allure the wild bird down; it must be called by one of the call-birds in the cages; and these, by being made to moult prematurely in a warm cage, call louder and better than those that are wild and at freedom. There even appears a malicious joy in these call-birds to bring the wild ones into the same state of captivity, while at the same time their call is louder, and their plumage brighter, than in a state of nature. Nor is their sight or hearing less exquisite, far exceeding that of the bird-catcher; for the instant the wild birds are perceived, notice is given by one to the rest of the call-birds, who all unite in the same tumultuous ecstacy of pleasure. The call-birds do not sing upon these occasions as a bird does in a chamber, but incite the wild ones by short jerks, which, when the birds are good, may be heard at a great distance. The allurement of this call is so great that the wild bird hearing it, is stopped in its most rapid flight; and, if not already acquainted with the nets, lights boldly within twenty yards perhaps of the bird-catcher, and on a spot which it would otherwise have quite disregarded. This is the opportunity wished for, and the bird-catcher pulling a string, the nets on each side rise in an instant, and clap directly down on the poor little unsuspecting visitant. Nay, it frequently happens, that if half a flock only are caught, the remaining half will immediately afterwards light between the nets, and share the fate of their companions. Should only one bird escape, this unhappy survivor will also venture into danger till it is caught; such a fascinating power have the call-birds.

Indeed, it is not easy to account for the nature of this call, whether it be a challenge to combat, an invitation to food, or a prelude to

courtship. As the call-birds are all males, and as the wild birds that attend to their voice are most frequently males also, it does not seem that love can have any influence in their assiduity. Perhaps the wild females, in these flights, attend to and obey the call below, and their male companions of the flight come down to bear them company. If this be the case, and that the females have unfaithfully led their mates into the nets, they are the first that are punished for their infidelity: the males are only made captives for singing; while the females are indiscriminately killed, and sold to be served up to the tables of the delicate.

Whatever be the motives that thus arrest a flock of birds in their flight, whether they be of gallantry or of war, it is certain that the small birds are equally remarkable for both. It is, perhaps, the genial desire that inspires the courage of most animals; and that being greatest in the males, gives them a greater degree of valour than the females. Small birds being extremely amorous, are remarkably brave. However contemptible these little warriors are to large creatures, they are often but too formidable to each other; and sometimes fight till one of them yields up his life with the victory. But their contentions are sometimes of a gentler nature. Two male birds shall strive in song till, after a long struggle, the loudest shall entirely silence the other. During these contentions, the female sits an attentive silent auditor, and often rewards the loudest songster with her company during the season.

Singing among birds is almost universally the prerogative of the male.[1] With them it is the reverse of what occurs in the human kind. Among the feathered tribe, the heaviest cares of life fall to the lot of the female. Hers is the fatigue of incubation, and to her devolves the principal fatigue of nursing the helpless brood. To alleviate these fatigues, and to support her under them, Nature has given the

[1] White, in his charming Natural History of Selborne, gives the following list of the *time of song* of British soft-billed birds.

Woodlark, (*Alauda arborea*). In January, and continues to sing through all the summer and autumn.

Song-thrush, (*Turdus simpliciter dictus*). In February, and on to August; resume their song in Autumn.

Wren, (*Passer troglodytes*). All the year, hard frost excepted.

Red-breast, (*Rubecula*). Ditto.

Hedge-sparrow, (*Curuca*). Early in February, to July the 10th.

Yellow-hammer, (*Emberiza flava*). Early in February, and on through July to August the 21st.

Skylark, (*Alauda vulgaris*). In February, and on to October.

Swallow, (*Hirundo domestica*). From April to September.

Black-cap, (*Atricapilla*). Beginning of April, to July 13th.

Titlark, (*Alauda pratorum*). From middle of April, to July 16th.

Blackbird, (*Merula vulgaris*). Sometimes in February and March, and so on to July the 23rd; re-assumes in autumn.

White-throat, (*Ficedulæ affinis*). In April, and to July 23.

Goldfinch, (*Carduelis*). April, and through to September 16.

Greenfinch, (*Chloris*). On to July and August 2nd.

Less reed-sparrow, (*Passer arundinaceus minor.*) May, on to beginning of July.

Common linnet, (*Linaria vulgaris*). Breeds and whistles on till August; re-assumes its note when they begin to congregate, in October, and again early before the flocks separate.

Birds that cease to be in full song, and are usually silent at or before Midsummer:—

Middle willow-wren, (*Regulus non cristatus*). Middle of June; begins in April.

Redstart, (*Ruticilla*). Ditto; begins in May.

Chaffinch, (*Fringilla*). Beginning of June, sings first in February.

Nightingale, (*Luscinia*). Middle of June; sings first in April.

Birds that sing for a short time, and very early in the spring:—

Missel-bird, (*Turdus viscivorus*). January the 2nd, 1770, in February. Is called in Hampshire and Sussex the storm-cock, because its song is supposed to forebode windy, wet weather. Is the largest singing bird we have.

Great titmouse, or ox-eye, (*Fringillago*). In February, March, and April; re-assumes for a short time in September.

Birds that have somewhat of a note or song, and yet are hardly to be called singing birds:—

Golden-crowned wren, (*Regulus cristatus*). Its note as minute as its person; frequents tops of high oaks and firs: the smallest British bird.

Marsh titmouse, (*Parus Palustris*). Haunts great woods; two harsh, sharp notes.

Small willow-wren, (*Regulus non cristatus*). Sings in March, and on to September.

Largest willow-wren. *Cantat voce stridula locustæ;* from end of April to August.

Grasshopper lark, (*Alauda minima voce locustæ*). Chirps all night, from the middle of April to the end of July.

Marten, (*Hirundo agrestis*). All the breeding time; from May to September.

Bullfinch, (*Pyrrhula*).

Bunting, (*Emberiza alba*). From the end of January to July.

Birds that sing as they fly are but few:—

Skylark, (*Alauda vulgaris*). Rising, suspended, and falling.

Titlark, (*Alauda pratorum*). In its descent; also sitting on trees, and walking on the ground.

Woodlark, (*Alauda arborea*). Suspended; in hot summer nights all night long

Blackbird, (*Merula*). Sometimes from bush to bush.

White-throat, (*Ficedulæ affinis*). Uses, when singing on the wing, odd jerks and gesticulations.

Swallow, (*Hirundo domestica*). In soft, sunny weather.

Wren, (*Passer troglodytes*). Sometimes from bush to bush.

Birds that breed most early in these parts:—

Raven, (*Corvus*). Hatches in February and March.

Song-thrush, (*Turdus*). In March.

Blackbird, (*Merula*). In March.

Rook, (*Cornix frugilega*). Builds in the beginning of March.

Woodlark, (*Alauda arborea*). Hatches in April.

song to the male. This serves as a note of blandishment at first to attract her affections; it serves as a note to delight her during the time of her incubation; but it serves still farther as a note of security, to assure her that no danger threatens to molest her. The male, while his mate is hatching, sits upon some neighbouring tree, continuing at once to watch and to sing. While his voice is heard, the female rests in confident security; and, as

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Ringdove, (*Palumbus torquatus*). Lays in the beginning of April.

To this list we may add the following beautiful passage on the *voices of birds*, by a brother naturalist, Mr Knapp.

We note birds in general more from their voices than their plumage; for the carols of spring may be heard involuntarily, but to observe the form and decoration of these creatures requires an attention not always given. Yet we have some native birds beautifully and conspicuously feathered; the goldfinch, the chaffinch, the wagtails, are all eminently adorned, and the fine gradations of sober browns in several others are very pleasing. Those sweet sounds, called the song of birds, proceed only from the male; and with a few exceptions, only during the season of incubation. Hence the comparative quietness of our summer months, when this care is over, except from accidental causes, where a second nest is formed; few of our birds bringing up more than one brood in the season. The red-breast, blackbird, and thrush, in mild winters, may continually be heard, and form exceptions to the general procedure of our British birds; and we have one little bird, the woodlark (*alauda arborea*), that, in the early parts of the autumnal months, delights us with its harmony, and its carols may be heard in the air commonly during the calm sunny mornings of this season. They have a softness and quietness, perfectly in unison with the sober, almost melancholy stillness of the hour. The skylark also sings now, and its song is very sweet, full of harmony, cheerful as the blue sky and gladdening beam in which it circles and sports, and known and admired by all; but the voice of the woodlark is local — not so generally heard—from its softness, must almost be listened for, to be distinguished, and has not any pretensions to the hilarity of the former. This little bird sings likewise in the spring; but at that season, the contending songsters of the grove, and the variety of sound proceeding from every thing that has utterance, confuse and almost render inaudible the placid voice of the woodlark. It delights to fix its residence near little groves and copses, or quiet pastures, and is a very unobtrusive bird, not uniting in companies, but associating in its own little family-parties only, feeding in the woodlands on seeds and insects. Upon the approach of man, it crouches close to the ground, then suddenly darts away, as if for a distant flight, but settles again almost immediately. This lark will often continue its song, circle in the air, a scarcely visible speck, by the hour together; and the vast distance from which its voice reaches us in a calm day is almost incredible. In the scale of comparison, it stands immediately below the nightingale in melody and plaintiveness; but compass of voice is given to the linnet, a bird of very inferior powers. The strength of the larynx and of the muscles of the throat in birds is infinitely greater than in the human race. The loudest shout of the peasant is but a feeble cry, compared with that of the golden-eyed duck, the wild goose, or even this lark. The sweet song of this poor little bird, with a fate like that of the nightingale, renders it an object of capture and confinement, which few of them comparatively survive. I have known our country bird-catchers take them by a very simple but effectual method. Watching them to the ground, the wings of a hawk, or of the brown owl stretched out, are drawn against the current of air by a string, as a paper kite, and made to flutter and vibrate like a kestrel over the place where the woodlark has lodged; which so intimidates the bird, that it remains crouching and motionless as a stone on the ground; a hand net is brought over it, and it is caught.

From various little scraps of intelligence scattered through the sacred and ancient writings, it appears certain, as it was reasonable to conclude, that the notes now used by birds, and the voices of animals, are the same as uttered by their earliest progenitors. The language of man, without any reference to the confusion accomplished at Babel, has been broken into innumerable dialects, created or compounded as his wants occurred, or his ideas prompted; or obtained by intercourse with others, as mental enlargement or novelty necessitated new words to express new sentiments. Could we find a people from Japan or the Pole, whose progress in mind has been stationary, without increase of idea, from national prejudice or impossibility of communication with others, we probably should find little or no alteration in the original language of that people; so, by analogy of reasoning, the animal having no idea to prompt, no new want to express, no converse with others, (for a note caught and uttered merely is like a boy mocking the cuckoo,) so no new language is acquired. With civilized man, every thing is progressive; with animals, where there is no mind, all is stationary. Even the voice of one species of birds, except in particular cases, seems not to be attended to by another species. That peculiar call of the female cuckoo, which assembles so many contending lovers, and all the various amatorial and caressing language of others, excites no influence generally, that I am aware of; with all but the individual species it is a dialect unknown. I know but one note which animals make use of, that seems of universal comprehension, and this is the signal of danger. The instant that it is uttered, we hear the whole flock, though composed of various species, repeat a separate moan, and away they all scuttle into the bushes for safety. The reiterated "twink twink" of the chaffinch is known by every little bird as information of some prowling cat or weasel. Some give the maternal hush to their young, and mount to inquire into the jeopardy announced. The wren, that tells of perils from the hedge, soon collects about her all the various inquisitive species within hearing, to survey and ascertain the object, and add their separate fears. The swallow, that shrieking darts in devious flight through the air when a hawk appears, not only calls up all the hirundines of the village, but is instantly understood by every finch and sparrow, and its warning attended to. As nature, in all her ordinations, had a fixed design and foreknowledge, it may be that each species had a separate voice assigned it, that each might continue as created, distinct and unmixed: and the very few deviations and admixtures that have taken place, considering the lapse of time, association, and opportunity, united with the prohibition of continuing accidental deviations, are very remarkable, and indicate a cause and original motive. That some of the notes of birds are as language designed to convey a meaning, is obvious from the very different sounds uttered by these creatures at particular periods: the spring voices become changed as summer advances, and the requirements of the early season have ceased; the summer excitements, monitions, informations, are not needed in autumn, and the notes conveying such intelligences are no longer heard. The periodical calls of animals, croaking of frogs, &c. afford the same reasons for concluding that the sound of their voices by elevation, depression, or modulation, conveys intelligence equivalent to an uttered

the poet expresses it, appears *most bless'd when most unseen*: but if any appearance of danger offers to intrude, the male, that a moment before was so loud and sportive, stops all of a sudden; and this is a most certain signal to his mate to provide for her own security.

The nest of little birds seems to be of a more delicate contrivance than that of the larger kinds.[1] As the volume of their bodies is smaller, the materials of which their nests are composed are generally warmer. It is easy to conceive that small things keep heat a shorter time than those that are large. The eggs, therefore, of small birds require a place of more constant warmth than those of great ones, as being liable to cool more quickly; and accordingly their nests are built warmer and deeper, lined on the inside with softer substances, and guarded above with a better covering. But it sometimes happens that the little architects are disturbed in their operations, and then they are obliged to make a nest, not such as they wish, but such as they can. The bird whose nest has been robbed several times, builds up her last in a very slovenly manner, conscious that, from the near approach of winter, she must not take time to give her habitation every possible advantage it is capable of receiving. When the nest is finished, nothing can exceed the cunning which the male and female employ to conceal it. If it is built in bushes, the pliant branches are so disposed as to hide it entirely from the view; if it be built among moss, nothing outwardly appears to show that there is a habitation within. It is always built near those places where food is found in greatest abundance; and they take care never to go in or out while there is any one in sight. The greater birds continue from their nest for some time, as their eggs take no damage in their absence; but the little birds are assiduous while they sit, and the nest is always occupied by the male when the female is obliged to seek for sustenance.

The first food of all birds of the sparrow kind is worms and insects. Even the sparrow and the goldfinch, that when adult feed only upon grain, have both been fed upon insects while in the nest. The young ones, for some time after their exclusion from the shell, require no food; but the parent soon finds, by their chirping and gaping, that they begin to feel the approaches of hunger, and flies to provide them a plentiful supply. In her absence they continue to lie close together, and cherish each other by their mutual warmth.

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sentence. The voices of birds seem applicable, in most instances, to the immediate necessities of their condition: such as the sexual call, the invitation to unite when dispersed, the moan of danger, the shriek of alarm, the notice of food. But there are other notes, the designs and motives of which are not so obvious. One sex only is gifted with the power of singing, for the purpose, as Buffon supposed, of cheering his mate during the period of incubation; but this idea, gallant as it is, has such slight foundation in probability, that it needs no confutation: and after all, perhaps, we must conclude, that listened to, admired, and pleasing, as the voices of many birds are, either for their intrinsic melody, or from association, we are uncertain what they express, or the object of their song. The singing of most birds seems entirely a spontaneous effusion produced by no exertion, or occasioning no lassitude in muscle, or relaxation of the parts of action. In certain seasons and weather, the nightingale sings all day, and most part of the night; and we never observe that the powers of song are weaker, or that the notes become harsh and untunable, after all these hours of practice. The song-thrush, in a mild, moist April, will commence his tune early in the morning, pipe unceasingly through the day, yet, at the close of eve, when he retires to rest, there is no obvious decay of his musical powers, or any sensible effort required to continue his harmony to the last. Birds of one species sing in general very like each other, with different degrees of execution. Some countries may produce finer songsters, but without great variation in the notes. In the thrush, however, it is remarkable, that there seems to be no regular notes, each individual piping a voluntary of his own. Their voices may always be distinguished amid the choristers of the copse, yet some one performer will more particularly engage attention by a peculiar modulation or tune; and should several stations of these birds be visited in the same morning, few or none probably will be found to preserve the same round of notes; whatever is uttered seeming the effusion of the moment. At times a strain will break out perfectly unlike any preceding utterance, and we may wait a long time without noticing any repetition of it. During one spring, an individual song-thrush frequenting a favourite copse, after a certain round of tune, trilled out most regularly some notes that conveyed so clearly the words, lady-bird! lady-bird! that every one remarked the resemblance. He survived the winter, and in the ensuing season, the lady-bird! lady-bird! was still the burden of our evening song; it then ceased, and we never heard this pretty modulation more. Though merely an occasional strain, yet I have noticed it elsewhere—it thus appearing to be a favourite utterance. Harsh, strained, and tense, as the notes of this bird are, yet they are pleasing from their variety. The voice of the blackbird is infinitely more mellow, but has much less variety, compass or execution; and he too commences his carols with the morning light, persevering from hour to hour without effort, or any sensible faltering of voice. The cuckoo wearies us throughout some long May morning with the unceasing monotony of its song, and though there are others as vociferous, yet it is the only bird I know that seems to suffer from the use of the organs of voice. Little exertion as the few notes it makes use of seem to require, yet, by the middle or end of June, it loses its utterance, becomes hoarse, and ceases from any further essay of it. The croaking of the nightingale in June, or the end of May, is not apparently occasioned by the loss of voice, but a change of note, a change of object; his song ceases when his mate has hatched her brood; vigilance, anxiety, caution, now succeed to harmony, and his croak is the hush, the warning of danger or suspicion to the infant charge and the mother bird.

[1] *Nests.*—On this subject we may refer here generally to Professor Rennie's work on the Architecture of Birds, published in the Library of Entertaining Knowledge, to which we have been already indebted in the course of our notes.

During this interval also they preserve a perfect silence, uttering not the slightest note, till the parent returns. Her arrival is always announced by a chirrup, which they perfectly understand, and which they answer all together, each petitioning for its portion. The parent distributes a supply to each by turns, cautiously avoiding to gorge them, but to give them often, though little at a time. The wren will in this manner feed seventeen or eighteen young ones without passing over one of them.

Such is the manner in which these birds bring forth and hatch their young; but it remains to usher them from the nest into life, and this they very assiduously perform. When they are fully fledged, and fitted for short flights, the old ones, if the weather be fair, lead them a few yards from the nest, and then compel them to return. For two or three succeeding days they are led out in the same manner, but each day to seek more distant adventures. When it is perceived that they can fly, and shift for themselves, then the parents forsake them for ever, and pay them no more attention than they do to other birds in the same flock. Indeed, it would seem among these little animals that, from the moment their young are set out, all future connection ceases between the male and female; they go separate ways, each to provide for itself during the rigours of winter; and, at the approach of spring, each seeks for a new associate.

In general, birds, when they come to pair in the spring, associate with those of their own age and place of abode. Their strength or courage is generally in proportion to their age: the oldest females first feel the accesses of desire, and the oldest males are the boldest to drive off all younger pretenders. Those next in courage and desire become pretenders, till they are almost all provided in turn. The youngest come last; as, in fact, they are the latest in their inclinations. But still there are several, both males and females, that remain unprovided for; either not happening to meet with each other, or at least not during the genial interval. Whether these mix with small birds of a different species, is a doubt which naturalists have not been able thoroughly to resolve. Addison, in some beautiful Latin lines, inserted in the Spectator, is entirely of opinion that birds observe a strict chastity of manners, and never admit the caresses of a different tribe.

"Chaste are their instincts, faithful is their fire,
No foreign beauty tempts to false desire:
The snow-white vesture, and the glittering crown,
The simple plumage, or the glossy down,
Prompt not their love. The patriot bird pursues
His well acquainted tints, and kindred hues:
Hence thro' their tribes no mix'd polluted flame,
No monster-breed to mark the groves with shame:
But the chaste blackbird, to its partner true,
Think's black alone is Beauty's fav'rite hue:
The nightingale, with mutual passion bless'd,
Sings to its mate, and nightly charms the nest.
While the dark owl, to court his partner flies,
And owns his offspring in their yellow eyes."

But whatever may be the poet's opinion, the probability is against this fidelity among the smaller tenants of the grove. The great birds are much more true to their species than these; and, of consequence, the varieties among them are more few. Of the ostrich, the cassowary, and the eagle, there are but few species; and no arts that man can use could probably induce them to mix with each other.

But it is otherwise with the small birds we are describing; it requires very little trouble to make a species between a goldfinch and a canary-bird, between a linnet and a lark. They breed frequently together; and produce a race, not like the mules among quadrupeds, incapable of breeding again; for this motley mixture are as fruitful as their parents. What is so easily done by art, very probably happens in a state of nature; and when the male cannot find a mate of his own species he flies to one of another, that, like him, has been left out in pairing. This, some historians think, may have given rise to the great variety of small birds that are seen among us; some uncommon mixture might first have formed a new species, and this might have been continued down, by birds of this species choosing to breed together.

Whether the great variety of our small birds may have arisen from this source cannot now be ascertained; but certain it is that they resemble each other very strongly, not only in their form and plumage, but also in their appetites and manner of living. The goldfinch, the linnet, and the yellow-hammer, though obviously of different species, yet lead a very similar life; being equally an active, lively, salacious tribe, that subsist by petty thefts upon the labours of mankind, and repay them with a song. Their nests bear a similitude; and they are all about the same time in hatching their young, which is usually fifteen days. Were I, therefore, to describe the manners of these with the same minuteness that I have done the greater birds, I should only present the reader with a repetition of the same accounts; animated neither by novelty nor information. Instead, therefore, of specifying each sort, I will throw them into groups; uniting those together that practise the same manners, or that are remarkable for similar qualifications.

Willoughby has divided all the smaller birds into those that have slender bills, and those that have short and thick bills. Those

with slender bills, chiefly live upon insects; those with short strong bills, live mostly upon fruits and grain. Among slender-billed birds he enumerates the thrush, the blackbird, the field-fare, the starling, the lark, the titmouse, the water-wagtail, the nightingale, the red start, the robin-redbreast, the beccafigo, the stone-chatter, the whin-chat, the gold-finch, the white-throat, the hedge-sparrow, the pettichaps, the golden-crowned wren, the wren, the humming-bird, and several other small birds of the sparrow-kind, unknown in this part of the world.

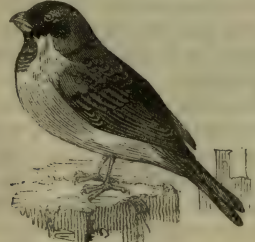
All these, as was said, live for the most part upon insects; and are consequently of particular benefit to man. By these are his grounds cleared of the pernicious swarms of vermin that devour the budding leaves and flowers; and that even attack the root itself, before ever the vegetable can come to maturity. These seek for and destroy the eggs of insects that would otherwise propagate in numbers beyond the arts of man to extirpate; they know better than man where to seek for them; and thus at once satisfy their own appetites, and render him the most essential services.[1]

But this is not the only merit of this tribe: in it we have the sweetest songsters of the grove; their notes are softer, and their manner more musically soothing, than those of hard-billed birds. The foremost in musical fame are the nightingale, the thrush, the blackbird, the lark, the red-breast, the black-cap, and the wren.

Birds of the sparrow-kind, with thick and short bills, are the gross-beak, the green-finch, the bull-finch, the crossbill, the house-sparrow, the chaffinch, the brambling, the gold-finch, the linnet, the siskin, the bunting, the yellow-hammer, the ortlan, the wheat ear, and several other foreign birds, of which we know rather the names than the history. These chiefly feed upon fruits, grain, and corn.—They are often troublesome to man, as

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[1] *The Sparrow.*—We have no bird more generally known, thought of, or mentioned with greater indifference, perhaps contempt, than the common sparrow (*fringilla domestica*), "that sitteth alone on the house-top;" yet it is an animal that Nature seems to have endowed with peculiar characteristics, having ordained for it a very marked provision, manifested in its increase and maintenance, notwithstanding the hostile attacks to which it is exposed. A dispensation that exists throughout creation is brought more immediately to our notice by the domestic habits of this bird. The natural tendency that the sparrow has to increase, will often enable one pair of birds to bring up fourteen or more young ones in the season. They build in places of perfect security from the plunder of larger birds and vermin. Their art and ingenuity in commonly attaching their nests beneath that of the rook, high in the elm, a bird whose habits are perfectly dissimilar, and with which they have no association whatever, making use of their structure only for a defence to which no other bird resorts, manifest their anxiety and contrivance for the safety of their broods. With peculiar perseverance and boldness, they forage and provide for themselves and their offspring; will filch grain from the trough of the pig, or contend for its food with the gigantic turkey; and, if scared away, their fears are those of a moment, as they quickly return to their plunder; and they roost protected from all the injuries of weather. These circumstances tend greatly to increase the race, and in some seasons their numbers in our corn-fields towards autumn are prodigious; and did not events counteract the increase of this army of plunderers, the larger portion of our bread-corn would be consumed by them. But their reduction is as rapidly accomplished as their increase, their love of association bringing upon them a destruction which a contrary habit would not tempt. They roost in troops in our ricks, in the ivy on the wall, &c., and are captured by the net: they cluster on the bush, or crowd on the chaff by the barn door, and are shot by dozens at a time, or will rush in numbers, one following another, into the trap. These and various other engines of destruction so reduce them in the winter season, that the swarms of autumn gradually diminish, till their numbers in spring are in no way remarkable. I have called them plunderers, and they are so; they are benefactors likewise, seeming to be appointed by Nature as one of the agents for keeping from undue increase another race of creatures, and by their prolificacy they accomplish it. In spring and the early part of the summer, before the corn becomes ripe, they are insectivorous, and their constantly-increasing families require an unceasing supply of food. We see them every minute of the day in continual progress, flying from the nest for a supply, and returning on rapid wing with a grub, a caterpillar, or some reptile; and the numbers captured by them in the course of these travels are incredibly numerous, keeping under the increase of these races, and making ample restitution for their plunderings and thefts. When the insect race becomes scarce, the corn and seeds of various kinds are ready; their appetite changes, and they feed on these with undiminished enjoyment.



We have scarcely another bird, the appetite of which is so accommodating in all respects as that of the house sparrow. It is, I believe, the only bird that is a voluntary inhabitant with man—lives in his society, and is his constant attendant, following him wherever he fixes his residence. It becomes immediately an inhabitant of the new farm-house, in a lonely place or recent inclosure, or even in an island; will accompany him into the crowded city, and build and feed there in content, unmindful of the noise, the smoke of the furnace, or the steam-engine, where even the swallow and the martin, that flock around him in the country, are scared by the tumult, and leave him: but the sparrow, though begrimed with soot, does not forsake him; feeds on his food, rice, potatoes, or almost any other extraneous substance he may find in the street; looks to him for his support, and is maintained almost entirely by the industry and providence of man. It is not known in a solitary and independent state.—*Journal of a Naturalist.*

they are a numerous tribe; the harvest often suffers from their depredations; and while they are driven off from one end of the field, they fly round, and come in at the other. But these also have their uses: they are frequently the distributors of seeds into different districts; those grains which they swallow are sometimes not wholly digested; and these, laid upon a soil congenial to them, embellish the face of nature with that agreeable variety, which art but vainly attempts to imitate. The mistletoe plant, which we often see growing on the tops of elm and other trees, has been thought to be propagated in this manner; yet, as it is often seen growing on the under side of the branch, and sometimes on a perpendicular shoot, it seems extraordinary how a seed could be deposited in that situation. However this be, there are many plants propagated from the depositions of birds; and some seeds are thought to thrive the better for first having undergone a kind of maceration in the stomach of the little animal, before it is voided on the ground.

There are some agreeable songsters in this tribe also; and those who like a loud piercing pipe, endued with great variety and perseverance, will be pleased most with their singing. The songsters of this class are the canary-bird, the linnet, the chaffinch, the goldfinch, the green-finch, the bull-finch, the brambling, the siskin, and the yellow-hammer. The note of these is not so generally pleasing as that of the soft-billed birds, but it usually holds longer; and, in a cage, these birds are more easily fed, and more hardy.

This class of small birds, like all the greater, has its wanderers, that leave us for a season, and then return, to propagate, to sing, or to embellish the landscape here. Some of this smaller kind, indeed, are called *birds of passage*, that do not properly come under that denomination; for though they disappear in one place they never leave the kingdom, but are seen somewhere else. But there are many among them that take longer flights, and go to a region colder or warmer, as it suits their constitutions. The fieldfare and the red-wing breed pass their summers in Norway, and other cold countries, and are tempted hither to our mild winters, and to those various berries which then abound with us, and make their principal food. The haw-finch and the crossbill are uncertain visitants, and have no stated times of migration. Swallows of every species disappear at the approach of winter. The nightingale, the black-cap, the fly-catcher, the willow-wren, the wheat-ear, the whin-chat, and the stone-chatter leave us long before the approach of winter: while the siskin and the linnet only forsake us when our winters are more than usually severe. All the rest of the smaller tribe never quit this country: but support the severest rigours of the climate.

Yet it must not be supposed that the manners of our little birds prevail in all other countries; and that such kinds as are stationary with us never wander in other parts of Europe; on the contrary, it happens that many of those kinds which are birds of passage in England are seen, in other places, never to depart, but to make one country their fixed residence the whole year round. It is frequent, that some birds, which with us are faithful residents, in other kingdoms put on the nature of birds of passage, and disappear for a season.

The swallow, that with us is particularly remarked for being a bird of passage, in Upper Egypt, and in the island of Java, breeds and continues the whole year, without ever disappearing. Larks, that remain with us the year throughout, are birds of passage in Sweden; and forsake that climate in winter to return again with the returning spring. The chaffinch, that with us is stationary, appears during the winter in Carolina and Virginia; but disappears totally in summer to breed in the northern regions. In Sweden, also, these little birds are seen returning, at the approach of spring, from the warmer climates, to propagate; which being accomplished by the latter end of autumn, the males and females separate; the males to continue among their native snows, the females to seek a warmer and gentler winter. On this occasion, they are seen in flocks, that darken all the air, without a single male among them, making their way into the more southern regions of Denmark, Germany, and Holland. In this Amazon-like retreat thousands fall by the way; some by fatigue, some by want; but the greatest number by the nets of the fowler; the taking them being one of the chief amusements among the gentry where they pass. In short, the change of country with all this little tribe, is rather a pilgrimage than a journey; a migration rather of necessity than of choice.

Having thus given a general idea of the birds of this class, it will be proper to give some account of the most remarkable among them.

CHAP. II.

OF THE THRUSH, AND ITS AFFINITIES.[1]

With the Thrush we may rank the red-wing, the field-fare, the blackbird, the ring-

[1] *Thrushes proper.* In all systems of ornithology the

ouzel, and the water-ouzel. These are the largest of the sparrow-kind, and may be distinguished from all others of this class, as well by their size, which is well known, as by their bills, which are a little bending at the point; a small notch near the end of the upper chap; and the outmost toe adhering as far as the first joint of the middle toe. To this tribe may be

thrushes and blackbirds have been united in the same genus, according to the generic characters common to both.

Four species of the thrush live in our climates: the thrush properly so called, the missel, the redwing, and the fieldfare. The two former pass the entire year in France, and also in the southern parts of this country. They have a very agreeable song, especially the thrush proper, which is also called the song-thrush and mavis. Dr Latham seems to think that this bird shifts its quarters in winter, in the north of England and Scotland. It probably leaves the country, or retires to the thick and solitary woods. Both these species are distinguished by never uniting in flocks for the purposes of migration. Their plumage has many traits of conformity in colour and distribution.

The redwings and fieldfares seldom appear among us until autumn, remain during the winter, and live in large flocks. They scarcely ever nestle here, and depart in spring, as they arrived in autumn, in numerous assemblages. As they quit us at the epoch of pairing, we are not acquainted with their love-notes. Often, previously to their departure, they are heard chirping all together, but in this loud noisy concert it would be vain to seek for harmony.

In all the species the males and females are of the same size, and their livery is pretty similar. The colours, however, are more lively and better defined in the males. Berries, fruit, and insects constitute the food of all. To these aliments they join earth-worms, in the pursuit of which they are observed to be very eager after rain. They also feed on snails, which, during winter, they seek in those places most exposed to the sun.

Their flesh is excellent for eating, especially that of the thrush, and the redwing when fat. In the vintage time, in the southern countries, it especially acquires that delicacy and exquisite flavour which occasion this small game to be much sought after by gourmands. Among the Romans it was in high esteem. It is said to possess qualities which, if real, should render it still more estimable. It excites, says its eulogizers, the appetite, fortifies the stomach, improves the juices, and is easy of digestion. It is, therefore, considered as peculiarly wholesome for convalescent subjects. It never produces any bad effect, provided it be not eaten to excess. It has been also thought in medicine to be an excellent anti-epileptic; this quality it is said to derive from the bird feeding on mistletoe, to which the same virtue has been attributed.

It may not be unamusing to our readers to notice the manner in which the Romans, with whom thrushes held the first rank among the feathered game, preserved these birds throughout the entire year, and fattened them in their extensive aviaries.

Each of these contained many thousands of thrushes, blackbirds, and other birds good for eating. They were so numerous in the neighbourhood of Rome, that thrush's dung was employed as manure to fertilize the land. It was also employed to fatten oxen and pigs. The thrushes were kept very closely confined, and considerably crowded. But their food was abundant and well chosen, and they grew fat rapidly. These aviaries were vaulted pavilions, furnished within with a great quantity of roosts. The doors were very low, there were but few windows, and always so turned, that the prisoners could see neither the woods nor country, nor even the birds which hovered outside, so that nothing might hinder them from growing fat. They were only left as much light as was necessary to enable them to distinguish what they chiefly wanted. They were fed with millet, which was peeled and pounded and formed into a kind of paste with bruised figs and flour; besides which they received berries of the mastic-tree, of myrtle, and of ivy, and every thing which could render their flesh succulent and high flavoured. A small rivulet of running water traversed the aviary, for them to drink from. Those which were intended to be eaten in succession, received for twenty days before they were taken for that purpose an augmentation of the best nutriment. Particular care was taken to make such as seemed fit for the table pass very quietly into a particular place which communicated with the aviary, and they were not taken until the communication had been closely shut, to prevent the others from being disturbed. To make them support their captivity with greater patience, the aviary was carpeted with green branches, and fresh turf, often renewed, and in fact, the better the proprietor understood his own interests the better the birds were treated. This method succeeded almost invariably in taming birds, however recently they might have been imprisoned. Those, however, which had been newly taken were kept for some time in small separate aviaries; and the better to accustom them to captivity, they were given as companions those who had been already habituated to their prison.

On the approach of vintage time innumerable flocks of thrushes quit the northern regions of Lapland and Siberia, and their abundance is so great on the southern coast of the Baltic, that Klein assures us that the city of Dantzic alone consumes every year eighty thousand pairs of them. The different species do not all arrive at the same time. The thrushes proper, or the song-thrushes, make their appearance first, then come the redwings, and finally the fieldfares and missels. They stop in various places, especially where they find the most abundant food, and the most easily obtained. They thus continue their route southward, arrive in certain countries sooner or later, in greater or less numbers according to the direction of the winds and the changes of temperature. This is universally the case with all the birds which are driven from the north, by the severity of the weather. Of the migratory thrushes, some nestle in the islands of the Mediterranean, and others continue their course even into Africa. They arrive, Sonnini tells us, in Egypt in the month of October, and do not leave that country until March. They remain at no great distance from habitations, and seek the shades of the orange and citron groves which adorn some districts of Lower Egypt. They do not all, however, proceed so far south. Many remain during the winter in our more northern climates, where tolerably numerous flocks of redwings and fieldfares are to be seen during this season. They frequent the meadows, and the green borders of woods, of which they quit the interior.

There are more snares laid, perhaps, for thrushes than for any other birds, and the pursuit of them is very profitable. Those which are most easily taken in snares or nooses are the song-thrush and the redwing. These snares are, as every body knows, composed of a few horsehairs twisted together and forming a running knot. They are set around juniper trees, &c., in the neighbourhood of some fountain or pond. If the snares are properly set, in a well-chosen place, many hundreds of thrushes may be caught in a day, while they are on their passage. Snares are also employed baited with different kinds of berries, and placed along the hedges. Thrushes are also caught in nets. The net should always be placed as nearly as possible on the side on which the wind blows upon the hedges and bushes; for it is ob-

also added the stare or starling, which, though with a flat bill, too much resembles these birds to be placed any where else.

The missel-thrush is distinguished from all of the kind by its superior size, being much larger than any of them. It differs scarcely in any other respect from the throstle, except that the spots on the breast are larger. It

served, that birds never sleep but with their heads with the wind. Autumn and spring, when the thrushes and blackbirds are on their passage, are the proper periods for catching them in great quantities, because they then repose in large flocks, in the hedges sheltered from the wind. Fowlers in France also make use of movable huts, which are very convenient for killing numbers of thrushes during the vintage time. These birds never repose in the vineyards, but retire into the neighbouring woods and thickets; and generally rest once or twice on the most exposed trees. The hunters have each a hut, which they place near the tree which they judge most advantageous, and there each awaits his game, which he kills easily. It is remarked that the riper the grapes are, the more frequently the birds repose themselves: they appear, as it were, intoxicated; and every kind of snare succeeds in taking them at this time.

The *Song-Thrush or Mavis.* This bird is well



known among us, and is one of the commonest species in the wine-countries in France; its flesh is the most delicate of any. It frequents the vineyards when the grapes are ripe, disappears after the vintage, and makes its appearance again in March or April. All the birds of this species, however, do not migrate; they are sometimes seen in winter in our climates, but few in number. They approach habitations and sojourn in hedges; but as soon as the spring expands its genial influence, they retire into the woods, and announce the return of this delightful season by their varied song. Accordingly, both here and in many other countries, they are called song-thrushes, or some equivalent name. The male usually perches on the summit of some lofty tree, on a thick branch, and remains singing there for hours. It continues its notes from the early days of spring to the month of August and sometimes later; it is often heard with us as early as February. At other times these thrushes have only a little whistling note, which may be expressed by the syllables *zipp, zipp.* In flying away, they particularly utter this cry, which may be perfectly imitated by placing the end of the finger in the mouth, pressing it strongly with the lips, and drawing it quickly away. In this manner they are driven into snares, and attracted within reach of gun-shot. This thrush makes its nest in bushes, and sometimes on a branch of a tree against the trunk, about ten or a dozen feet high: the exterior is composed of dry herbs and moss, and the interior of straw, cemented with clay and rotten wood. The eggs are five or six in number, of a pale blue, with a slight greenish cast, and some reddish and black spots. The male and female share the incubation. After the first brood is hatched, the latter recommences a second, and sometimes even a third, especially when the first has not thriven. Each brood goes separately, and the little ones disperse when they are strong enough to take care of themselves. These thrushes do not fly in flocks; still many are found together, or at no great distance from each other. The species is extended through all Europe, is fonder of woods than other places, especially of such as abound in maple trees. These thrushes possess no great degree of cunning, and suffer themselves easily to be taken with snares and bird-calls. When they cannot find fruits and berries, they subsist on snails, insects, and worms. This is the reason that they are found on the ground so frequently in the woods, and at the foot of hedges and bushes, especially those which border submerged meadows. When they are looked at, they manifest their displeasure by a gnashing of the bill. To bring up this bird in a cage, it must be taken young, so that it will sing all the better. It is fed with a sort of paste such as is made for nightingales, or it may be made with crumbs of bread, rape-seed, or hemp-seed bruised, and meat cut small. This aliment is varied with grapes or other fruits of which the bird is fond. This thrush is susceptible of education, learns even to speak, and whistles very agreeably many airs of the bird-organ and flageolet. It will live in captivity generally from seven to eight years. There are many varieties of this thrush, but all of them accidental. Among these may be remarked the white thrush, whose plumage, however, is not in general of a pure white. On some parts of the body spots of a feeble shade and undefined form are observable. In other individuals the plumes of the back are mixed with brown, and some red is observable on the breast. Sometimes the top of the head alone is white, and at others there is only seen a demi-collar of this hue.

The *Chochi,* or thrush of Paraguay, utters a singular sound towards the setting of the sun during the hatching season: it cries in a melancholy tone like the mewling of a cat, yet during the day, at the same epoch, its song is varied, frequent, and agreeable. It preludes with the syllables *chochi-chochi-toropi,* repeated three or four times, from which M. Vieillot has given it its name. The chochi composes its nest of small and very flexible branches, furnished with slips of roots, and covered with an extremely thick coating of cow-dung, mixed with sand.

The *Missel* is the largest of all the European thrushes. It is like many other birds that people our woods and orchards, partly migratory, and partly sedentary. In Lorraine, according to Dr Lottinger, the missels quit the mountains at the approach of winter, always fly in flocks in spring and autumn, return in March, and nestle in the forests with which these mountains are covered. In Brie, according to Hebert, the correspondent of Buffon, they do not unite in flocks at any season of the year. If those two observers speak of the same species of thrush, it would appear that its habits are not the same in all countries. The greater number of the missels quit our northern climates on the approach of winter, but some remain. Those certainly do not live in flocks like the fieldfares, but in families. They pair in the month of January, and once coupled, each pair lives separately.

The missel is one of the first of our sedentary birds which announce the return of spring; for even so early as the fine days of February the male perches on the top of a very lofty tree, and puts forth a varied song, which, though remarkably loud, is not destitute of harmony. The female makes her nest even previously to the

builds its nest in bushes, or on the side of some tree, as all of this kind are found to do, and lays four or five eggs in the season. Its song is very fine, which it begins in spring, sitting on the summit of a high tree. It is the largest bird of all the feathered tribe that has music in its voice; the note of all greater birds being either screaming, chattering, or

setting in of spring, and places it on large trees, but more generally on those of a middling height. She constructs it in the bifurcations of the principal branches, employs moss, leaves, and large weeds outside, cemented with earth, and carpets the nest with fine plants within, horsehair, and wool, and covers the exterior very artfully with moss like that which grows on the tree itself. She seldom lays more than four eggs, of obscure white, spotted with brown, and the male partakes the incubation. They feed the young ones with caterpillars, small worms, slugs, and snails, whose shells they break. A second brood is generally hatched after the first, and when both are ended the families unite, and add to the aliments just mentioned various kinds of berries, cherries, grapes, and other fruits. In winter they feed on flax-seed, hops, ivyberries, buckthorn, and particularly mistletoe; from which our name of missel-thrush is given to them. In Burgundy they are called *Draines*, from a peculiar cry which they continually repeat, either as a rallying or a warning signal, and which has some fancied resemblance to this word. Montbeillard tells us that the missel-thrushes are very pacific in their manners; but Le Vaillant, with more appearance of truth, declares that his observation is without foundation. They are, in fact, of a quarrelsome nature, and often fight either for food or the choice of a companion. The males are more numerous than the females, and it is not rare to see two or three of them disputing so bitterly, that they forget their natural distrust, and suffer themselves to be approached very closely. The combat does not cease until the most feeble have abandoned both the object of their quarrel, and the district which she inhabits. Those which establish themselves in orchards prove very vigilant sentinels for our poultry, which they always warn of the approach of birds of prey. They seek to take under their protection all the little birds which nestle in the same quarter with themselves. If a kestrel, a hawk, a crow, or a jay should appear in the neighbourhood, the male directly announces its presence by a cry of uneasiness; the female joins him, and on their united cries, repeated with every tone and accent of anger, an entire cohort of little birds, especially finches, join with them in pursuit of the common enemy, and succeed in terrifying him, and obliging him to take to flight before his feeble adversaries.

The missels are very distrustful, much more so than the blackbirds. It is very difficult to surprise them, except at hatching time; then they can be approached more easily: they are so much absorbed in the care of incubation, that they will allow themselves sometimes to be taken on the nest. They generally escape all kinds of snares, and can never be caught with the bird-call. They are sometimes observed to join with the finches in insulting the howlers, which daylight has surprised out of their retreat. The missel may be sometimes taken by the noose, but not so frequently as the song-thrush and the redwing. Their flesh is not so much in estimation as that of other thrushes, at least in our more northern climates, which is attributable to the sort of aliment on which they subsist. When they live on grapes, olives, and other succulent fruits, its flavour must be equal to that of the flesh of the others; but hips, flax-seed, and berries in general, which are deficient in nutritive qualities, impart to it a disagreeable taste, and cannot produce the delicate fat which renders the other thrushes so highly esteemed in some places as an article of game. These birds must be taken in the nest, when they are first covered with feathers, if they are meant to be tamed. Crumbs of bread steeped in water, and the yolks of eggs, constitute a proper food for them at this season; when they will eat of their own accord they may have worms, snails, berries of various kinds, and minced apples.

The *Fieldfare of Canada* is a well-tempered and familiar bird. Its song is more varied and melodious



than that of the missel, and has equal compass; its throat is more flexible; it is heard to utter the short interrupted cry of our blackbird, which it accompanies with a gnashing of the beak, a vertical motion of the tail, and slight tremor of the wings. It generally places its nest on trees of middling size, and composes it of small roots and dried herbs, bound together with a cement of clay. This nest perfectly resembles that of our song-thrush; the eggs are four or five in number, of a clear blue, varied with obscure spots.

The fieldfares come among us from the north of Europe, in November and December. They delight in fallow-lands, in places where flax-seed is found. Towards the end of winter they prefer humid meadows, and do not frequent woods, except to pass the night there. During this entire season they live in society, travel together, and remain all the winter without separating, perch all on the same or the most neighbouring trees; it is not rare to see them assembled to the number of two or three thousand, in places where the lotus grows, the fruit of which they eat with avidity. The fieldfares also subsist on slugs and worms, which they are observed to pursue eagerly after rain in humid soils, or grounds newly ploughed. When these aliments are wanting, they eat mistletoe, and various berries, among which are those of the whitethorn. They disappear in spring, but a few remain to the end of April. Then they are found in pairs, as this is the coupling time. The male is easily distinguished at this epoch from the female; the gray of his head and neck assumes a bluish tint, tolerably brilliant; the beak is of a fine yellow, and its extremity of a decided black. These couples may be sometimes observed, after a long winter, on the borders of thickets, far remote from habitations, but they are seen no longer when May sets in. Those fieldfares which are late go then to rejoin their companions, and pass the summer in the north, where they hatch their young. We can affirm nothing respecting the song of these birds, as we do not see them during the love season. The male and female with us utter the same cries, whether for warning or rallying. It is said that in Poland and Lower Austria, and Linnæus and Meyer add in Sweden, they nestle on high trees, and lay four or six eggs, of a sea-green, pointed with reddish-brown. M. Vieillot says they never nestle in our climates. This may be true of France, but Dr Latham mentions an instance or two of the fieldfare's nest being found in this country. Their flesh is not so

croaking. It feeds on insects, holly, and mistletoe-berries; and sometimes sends forth a very disagreeable scream when frighted or disturbed.

The blackbird, which in cold countries, and particularly upon the Alps, is sometimes seen all over white, is a beautiful and canorous bird, whistling all the spring and summer time with a note, at a distance, the most pleasing of all the grove. It is the deepest

much esteemed as that of other thrushes; some say it acquires a good flavour when the birds feed on flax-seed, others that it is never better or more succulent than when they live on worms or insects. In general, however, it is insipid enough. The fieldfares may be taken by net, bird-call, or snares of any kind; shooting them is an easy sport. There are many accidental varieties of this species, in which white predominates more or less.

The *Redwing* has been sometimes confounded with the song-thrush; but besides that its plumage is somewhat different, its habits and mode of life are analogous to those of the fieldfare. Like the latter, it only appears among us twice a year, unites in numerous flocks at certain hours of the day, to chirrup all together. The redwing has some conformity with the song-thrush in the delicacy of its flesh, and fondness for grapes, and they sometimes travel in company, especially in spring. The redwing generally arrives after the song-thrush, and before the fieldfare, from the north. They are seen in considerable flocks in November, which usually disappear before Christmas. It re-appears towards spring, in the month of March, and is not seen after April. Its cry is *tan, tan, kan, kan*. In constantly repeating this cry it leads the fox, its natural enemy, to a considerable distance after it. It has been remarked that it does not sing in our climate, and has only a chirrup very analogous to that of the linnet; it is said, however, that in its native country its song is very agreeable in the spring season, especially when it perches on the summit of lofty trees. It makes its nest in the woods in the neighbourhood of Dantzic; it nestles also, according to Nozemann, in some parts of Holland, and chooses those which are covered with elder and service-trees, of the berries of which it is very fond. It has two broods every year, in the months of April, May and June: each consists of from four to six eggs, of a greenish-blue, and spotted with blackish. It nestles also in Sweden, and places its nest on the small shrubs and in the hedges. While the female hatches, the male hunts, and brings her her food. From the analogy between this bird and the song-thrush, it would seem probable that the male also partakes the care of incubation. Nozemann says that the male and female of this species swallow the excrement of the young while they remain in the nest. This habit is common to them with many other birds, but the excrements remain at the entrance of their œsophagus, and they eject them in some spot away from the nest, so as to remove all suspicion of the place where their young family is concealed. The usual aliment of these birds consists of the small worms, which they procure by scraping up the earth, of berries, of turnips, and caterpillars. When these are wanting, they have recourse to cherries, grapes, and other kinds of tender fruits. Then it is that their flesh acquires the delicacy which renders it in equal estimation with that of the song-thrush. They are not mistrustful, and are more easily ensnared than almost any bird.

The *Punctated Thrush* is a native of New Holland, and has been well described by Mr Vigors and Dr Horsefield, in the fifteenth volume of the Linnæan Transactions. The general colour of the plumage is brown, inclining to olive; breast ash-colour, and belly rufous-buff; a white streak over the eye, and chin and throat white; tail greatly wedged, and legs pale-yellow.

We shall now speak of the *Blackbirds*.

Some naturalists distinguish the blackbirds generally from the thrushes by the vertical motion of the tail; but this is found among some species of the latter.

The *Blackbird* is solitary, living either alone or in company with its female. Though naturally wild, it is



more easily tamed than the thrushes. It sojourns and nestles near inhabited places; it is more distrustful and subtle, and is said to have a more piercing sight, which enables it to discover the fowler at a great distance: it is therefore approached with much more difficulty. The male has a powerful voice, but hardly supportable, except in the woods, or champaign country. It commences its notes from the first fine days in the month of February, and continues to sing until the fine season is pretty well advanced; it sings one of the longest of any of our birds. The love season begins early with the blackbird, and it is not rare to see young ones at the commencement of May. This species has two or three broods every year; it builds its nest in thick bushes, at a moderate height, or in the old trunks of headless trees, covered with ivy; it is composed of moss, small roots, and dried herbs, bound together with clay, and the interior is furnished with the softest materials. The male and female work together at its construction with so much assiduity, that we are assured that eight days are sufficient for the finishing of the work. When it is finished, the female deposits in it from four to five eggs, of a bluish-green, with rusty-coloured spots, frequent, and not very distinct. She hatches them with so much ardour, that she sometimes suffers herself to be caught with the hand on the nest.

These birds are sought after, and brought up in captivity for their song, and more especially for their power of improving it, of retaining the airs which they are taught, and imitating those which they hear. Those who are desirous of bringing them up should take them in the nest, when they are feathered, and feed them at first with a liquid paste, composed of steeped bread, yolk of egg, and bruised hempseed, and afterwards with sheep's-heart, minced meat, crumbs of bread, and different fruits and berries. They must not be shut up with other birds, for, naturally uneasy and petulant, they will pursue and torment them continually, unless in very large aviaries, filled with shrubs and bushes. In this way, indeed, they may have the pleasure of making their own nests, and bringing up their young, if they are provided with a sufficient quantity of the proper aliment. To succeed completely, it is necessary to abstain from approaching the brood while the little ones are not entirely fledged, for otherwise the old ones will either abandon or devour them. The blackbirds are very fond of bathing themselves; they must, therefore,

toned warbler of the woods; but it is rather unpleasant in a cage, being loud and deafening. It lays four or five bluish eggs, in a nest usually built at the stump of some old hawthorn, well plastered on the inside with clay, straw, and hair.

Pleasing, however, as this bird may be, the blue-bird, described by Bellonius, is in

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have plenty of water, which contributes not a little to their gaiety. Their moulting commences at the end of summer, and is so complete, that some are frequently seen at that period with the head entirely divested of feathers. At this epoch they cease to sing, and, generally, near its termination they proceed to migrate. Some few, however, are observed to remain the winter: they then inhabit hedges and the thickest woods, seeking those where there are warm springs and evergreen trees, as much for a shelter from the cold, as for the purpose of procuring sustenance. They come at this season into gardens, and feed on snails; they even seek them in the holes of walls, and know very well how to break the shell and extract the animal. Their flesh is considered very delicate during the vintage time in wine countries, and is as much in request as that of thrushes; but it grows bitter when they feed only on juniper-berries, ivy-berries, and other such fruits. It is said to have some medicinal properties, and to be good in fluxes and dysenteries. Nevertheless, ulcerated and hemorrhoidal patients should abstain from it; the oil in which blackbirds are cooked is much recommended by foreign physicians, in cases of sciatica; and the dung of these birds, dissolved in vinegar, is said to clear the skin, and disperse redness and blotches, if constantly used.

Though these birds are very distrustful and subtle, they give easily into the snares that are laid for them, provided the fowler be invisible. A method of taking them, well known to shepherds and the inhabitants of the country, consists in making a little hole in the ground, about five inches broad, eight long, and nine deep. In the bottom are placed various berries, or earth-worms, attached to a little stick with a thread, or transfixed through the body with long horns. If other birds are wanted to be taken, grains and other aliments are cast into the bottom of the hole, especially those of which they eat in preference. They then take a piece of turf, a tile, or a stone of the size of the hole, and place them on a sort of figure of 4, so arranged on the hole that the bird cannot come to the bait without touching the stick, and making the coverlet fall, which shuts them up in the hole. To draw the blackbirds more effectually, a tame one is sometimes fixed at the side of the snare, either on a stick, or otherwise. This method succeeds well in winter, when the birds are pressed for food, and will go any where in search of it.

Nothing so opposite as white and black; yet we see the first colour pass abruptly into the second, without going through the intermediate shades. Blackbirds, crows, and other birds of the same hue, present examples of this every day. Among the accidental varieties of this species, we find some completely white, including even the bill and feet. Some have these parts yellow, others have the bill red. Individuals have been observed, whose entire plumage was of a yellowish-rose colour, with the bill and feet yellow. On some specimens the head alone is white, with three oblong black spots placed behind the eyes; the iris, the beak, and the feet are yellow. Others are varied with black and white, in transversal spots on the upper parts, and longitudinal underneath; some have the wings and tail only as white as snow: all the rest of the plumage is a fine black. Finally, young ones are sometimes seen which have the alar and caudal quills white from their origin, and for half their length.

The *Ring-Ouzel* is decidedly a different species from the last. To say nothing of the plumage, &c., its habits and manners are different; its usual cry is *cr, cr, cr.* In spring its song is less loud than that of the common blackbird, and varied with sweet and melodious sounds. It is a bird of passage with us, and is never seen but in spring and autumn. It does not always pursue in its migrations a regular route; it usually follows the chains of mountains, and particularly seeks hedges, where ivy is abundant, of the berries of which it is especially fond. It is seen regularly enough in the months of April and October, on the mountains in the neighbourhood of Rouen. It sometimes remains there during the entire summer, but very rarely. These blackbirds appear to travel in families only, for seldom more than eight or twelve are seen together. They do not quit the hedges, and prefer those which are on the summit of mountains, and on the borders of woods. In both seasons, their passage does not continue for more than from fifteen to twenty days; for all this time they are excessively fat, and their flesh is very delicate eating. These birds have this peculiarity, that they are as fat in spring as in autumn, while the reverse is altogether the case with the other blackbirds and thrushes, and indeed with all other small birds, which are very fat in autumn, and quite lean in spring. Less distrustful than the common blackbirds, the ouzels suffer themselves to be approached without difficulty. It is said, however, that they are not very easily caught in snares. Still it would appear that they might be taken without much trouble in the spider-nets that we have described; as whenever they are pursued they stick constantly to the hedges, preferring those which are in a right line, and quitting one only, cast themselves into the succeeding.

This species is common in all the high mountains of England and Scotland, of Sweden, Auvergne, Savoy, Switzerland, and Greece. It also inhabits the mountain chain of the Vosges, where it nestles on the fir-trees. It also places its nest at times, at a small distance from the ground, either on a rock covered with bushes and large briars, or at the foot of a very thick bush; branches, roots of heath, and moss heaped together without order form the basis of the nest, the outside of which is furnished with thick weeds, and the inside with clay mixed with filaments of roots and dried leaves: fine and soft plants form the bed, on which the female lays four eggs, of the same size and colour with those of the common blackbird, but very remarkable for the large reddish spots with which they are marked.

The *Rock-thrushes* (as their name indicates) are inhabitants of the rocks and mountains, and must be sought for in the wildest and most solitary retreats: continually on their guard, they do not hestitate to stand in exposed places. They are frequently seen at some distance from their haunts, perched on large stones; but they are very difficult to approach, and very rarely stop within range of gun-shot. When they are advanced upon a little too much, they are off to another stone, and always choose one where they can have a full, commanding view of all that surrounds them. These birds are not a bad eatable, but they are still more in estimation for their voice, which is sweet and varied, approaching the tones of the black-headed warbler. Their throat is so flexible, that they quickly appropriate the song of other birds, and the airs of music. A little before sunrise, and at sunset, they utter the loudest sounds. During the day their song amounts to little more than chirping; but in the middle of the night, if their cage be approached with a light, they begin to sing directly. The extreme distrustfulness of these birds naturally leads them to choose the most inaccessible places for the security of their young family. They make their nests in the holes of rocks and attach them also to the roofs of caverns. It is

every respect far superior. This beautiful animal entirely resembles a blackbird in all but its blue colour. It lives in the highest parts of the Alps, and even there chooses the most craggy rocks and the most frightful precipices for its residence. As it is rarely caught, it is in high estimation even in the countries where it breeds, but still more valu-

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not without much risk and labour that their young brood can be got at; and even when the robber arrives at the place, a sure danger awaits him of having his eyes plucked out by these birds, which are not less courageous than distrustful, and will defend their young with desperate obstinacy. Their eggs are four or five in number, of a greenish-blue.

The *rose-coloured Blackbird* pleases the eye by the beauty and brilliancy of its plumage, but it also possesses other qualities far more valuable. It is a great destroyer of grasshoppers, locusts, &c. of which it devours an incredible number every day in the various parts of the east. It was regarded by the ancients, who called it *Seleucida*, as a favour of the gods, when these scourges, more destructive to the productions of the earth than hail and tempest, devastated the country. Even at present, the Arabs, the Indians, and the inhabitants of Aleppo are accustomed by superstitious practices to invoke this bird, which they call the *Samarmar*, to come to the succour of the crops, which are attacked by myriads of locusts. The Turks esteem it a sacred bird, and will not suffer it to be killed in their presence. It would be well if their example was more generally imitated with respect to all birds that render similar services to mankind. It would appear that this blackbird has no song, at least ornithologists and travellers make no mention of it. According to Forskel, its cry is heard at a great distance, and may be expressed thus: *tr, tr, tr*. This species appears spread through the hottest and coldest parts of the old continent. Forskel has seen it on the burning sands of Arabia, and in the plains of Aleppo, in July and August. Le Vaillant has met with it in Africa, as high as 24° south latitude. It has been sent into this country from Bengal. Pallas has found it in the north of Siberia, in the mountainous vicinity of the Irtish, where it nestles. Very numerous flocks of these birds traversed Provence and Piedmont, in the autumn of 1817. They are found in the mountains of Lapland, are common on the shores of the Caspian, near Astracan, and along the entire extent of the Volga. They pass every year in large flocks into the southern part of Russia. The rose-coloured blackbirds, which are seen on the continent, come only during the passage time of other birds; at this period many are observed in Burgundy. Klein assures us, that they have a name in Spanish, which indicates that they are known in Spain. Aldrovandus, the first naturalist who has mentioned these birds, informs us, that they sometimes appear in the plains of Bologna, where the fowlers call them sea-starlings. They perch on dunghills, grow very fat, and their flesh is good eating. They have been sometimes seen in this country.

The *Mocking-thrush*, properly so called, or *Mocking-bird*, derives its name from the peculiar talent which it



possesses of imitating the cries and a part of the song of other birds; but it does not give a caricatured imitation of those foreign sounds its denomination would appear to indicate; on the contrary, if it imitates it is only to embellish. The cries and half-phrases with which it enriches its own naturally varied song, have occasioned the aborigines of Mexico to give it a name far more appropriate and more justly applicable, that of *Cencontlatolli*, which means *four hundred languages*. This bird not only sings with taste, and without monotony, but also with action and animation. It is, perhaps, one of the first of singing birds; but to place it above the nightingale, with Fernandez, Nieremberg, and others, can only be done by those who have never heard, or who have entirely forgotten the song of that delightful bird. The voice of the mocking-thrush is more loud and powerful, but by no means so agreeable within a certain distance. Its song has little of the softness, delicacy, and plaintive tenderness that so peculiarly characterize the nightingale during the season of love. As there is no bird among the Americans at all to be compared to the mocking-bird, it is not astonishing that they should have exalted it into so extraordinary a character, and raised it above all other birds. They have, however, exaggerated its talents, in stating that it can imitate completely, and in all their parts, the song of other birds, the cries of different quadrupeds, the crying of infants, the laughter of a young girl, and in being able to repeat entire airs on the same key in which it has heard them. It does not possess the imitative talent to this degree, even in captivity. The mewing of the cat, however, it takes off so completely as to deceive any ear. (See note at page 146.)

This bird is very common in St Domingo, where it is called the nightingale; but there it possesses none of those qualities so much vaunted in North America. Its song, however, is the same. It frequents the savannahs, delights to be near habitations, and seems to love the society of man, the sight of whom is alone sufficient to excite it to sing. This bird moves the tail up and down, and often carries it in a raised position: at such times its wings are pendant. Bold and courageous, the mocking-thrush is frequently at war with the *pipiris*, and forces the little birds of prey to quit the places which it has adopted for its own abode, especially during the hatching-time. It places its nest on trees of middle size, or in thick bushes, gives it a similar form to that of the missel, and furnishes the base without with thorny branches. It lays four or five eggs, spotted with red points on a white ground, which points are larger towards towards the thick end than elsewhere. It feeds on insects and different berries. It is brought up in cages, but to preserve it, it must be taken in the nest, and its tastes and wants be carefully studied and administered to. When this is done, it will continue to sing many years. It is about the size of the redwing, and the female is of the same dimensions with the male.

We pass on to the LORIOTS or ORIOLES.

The *Oriole*, properly so called, and *golden Oriole* of Latham, comes into France about the middle of spring, and quits in autumn to pass the winter in Africa. It migrates at uncertain periods into England and Sweden. On their arrival, the male and female soon couple, and place their nest at the extremity of the branches of very elevated trees. This nest is constructed with much art and industry: it is attached to the bifurcation of two small branches; the birds enlace around the two branches, which form this bifurcation, long threads of straw, flax, or wool, some of which going right from one branch to another, form the edge of the nest in front, and the

able when carried from home. It not only whistles in the most delightful manner, but speaks with an articulate distinct voice. It is so docile, and observes all things with such diligence, that though waked at midnight by any of the family, it will speak and whistle at the word of command. Its colour, about the beginning of winter, from blue becomes black, which changes to its original hue on the first approaches of spring. It makes its nest in deep holes, in very high and inaccessible solitudes, and removes it not only from the accesses of man, but also hides it with surprising cunning from the shammoy and other wild beasts that might annoy its young.

The manner of taking this beautiful bird is said to be this. The fowlers, either by chance or by lying in wait, having found out the place where it builds, take with them a strong stilt or stake, such as the climbers of rocks make use of to assist them in their ascent. With the assistance of this, they mount where an indifferent spectator would think it impossible to ascend, covering their heads at the same time to ward off any danger of the falling of pebbles or stones from above. At length, with extreme toil and danger, having arrived at the nest, they draw it up from the hole in which it is usually buried, and cherish the young with an assiduity equal to the pains they took to obtain them. It produces for the most part five young, and never more; it seldom descends into the plain country, flies swifter than a blackbird, and uses the same food.

The fieldfare and the redwing make but a short stay in this country. With us they are insipid tuneless birds, flying in flocks, and excessively watchful to preserve the general safety. All their season of music and pleasure is employed in the more northern climates, where they sing most delightfully, perched among the forests of maples, with which those countries abound. They build their nests in hedges; and lay six bluish-green eggs spotted with black.

The stare, distinguishable from the rest of this tribe by the glossy green of its feathers in some lights, and the purple in others, breeds in hollow trees, eaves of houses, towers, ruins, cliffs, and often in high rocks over the sea. It lays four or five eggs of a pale greenish ash-colour, and makes its nest of straw, small fibres of roots, and such like. Its voice is rougher than the rest of this kind: but what it wants in the melody of its note, it compensates by the facility with which it is taught to speak. In winter these birds assemble in vast flocks, and feed upon worms and insects. At the approach of spring they assemble in the fields as if in consultation together, and for three or four days seem to take no nourishment: the greater part leave the country; the rest breed here, and bring up their young.[1]

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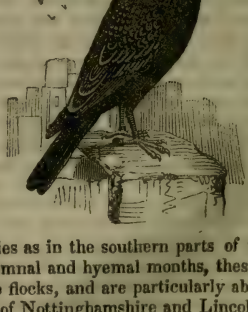
others penetrating into the tissue of the nest, or passing underneath and rolling over the opposite branch, give solidity to the work. Between the exterior and interior, there are moss, lichens, and other similar matters. The interior is furnished with wool, spiders'-webs, the silky nests of caterpillars, and feathers, the whole united and tissued most intimately and ingeniously together. The eggs are four or five in number, of a dirty white, sprinkled with little spots of a blackish-brown, and more numerous towards the thick end. Incubation lasts about one-and-twenty days.

The song of the oriole is tolerably well known, and has given rise to the different names imposed upon the bird, according as the hearers have thought proper to express it, or as they believed that they heard it. Some believe that it always cries *Yo, yo, yo,* syllables which are always preceded or followed by a sort of mewing, like that of a cat. Others that it pronounces *Oriot* or *Loriot.*

The oriole is not easily reared in captivity: this, however, may be achieved, and even the old ones taken with the young may be preserved for some time, if they receive plenty of those fruits of which they are particularly fond. As to the young taken from the nest, they are fed at first with the same paste which is given to nightingales, and afterwards with fruits. These birds seldom live more than two years in captivity; they most generally perish, from a species of gout which attacks them in the feet. The oriole is extremely distrustful, and very difficult of approach. Precaution must be used when it is intended to shoot them, as they fly from tree to tree for a long time, without suffering themselves to remain to be aimed at. They can be attracted by whistling like them, but it must be well done, and exactly like their voice, as, otherwise, they will fly off immediately. In the fruit season they may be caught with various kinds of snares.—All that we have said of the habits of this oriole is applicable to the other species of the genus as far as they are known.—*Supplement to the English Edition of Cuvier's Animal Kingdom.*

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[1] The *Starling* is widely dispersed through Great Britain, occurring as numerously in the Orkney and



Shetland isles as in the southern parts of the kingdom. In the autumnal and hyemal months, these birds gather in immense flocks, and are particularly abundant in the fenny parts of Nottinghamshire and Lincolnshire, where they roost among the reeds. Before they retire to rest, they perform various manœuvres in the air, the whole frequently describing rapid revolutions round a common centre. This peculiar flight will sometimes continue for nearly half an hour, before they become finally settled for the night. Upon the approach of spring they pair, and spread themselves over the country.—They build in the holes of trees, or in ruinous buildings, making an

To this tribe might be added above a hundred other birds of nearly the thrush size, and living like them upon fruits and berries. Words could not afford variety enough to describe all the beautiful tints that adorn the foreign birds of the thrush kind. The brilliant green of the emerald, the flaming red of the ruby, the purple of the amethyst, or the bright blue of the sapphire, could not, by the most artful combination, show any thing so truly lively or delightful to the sight, as the feathers of the chilcoqui or the tautotal. Passing, therefore, over these beautiful, but little known, birds, I will only mention the

artless nest of dry grass or hay, on which four or five eggs of a bluish-green colour, are deposited.—Their food principally consists of worms and other insects; but they also eat grain and various seeds. The starling is a very imitative bird, and, when tamed, may be taught to articulate very distinctly, and to whistle tunes with much precision. In its wild state even, it may frequently be heard endeavouring to imitate the cries of different birds and animals. Its own peculiar notes are a shrill whistle, and chattering kind of noise. It is found throughout Europe; and the same species appears to be common also in Asia, as I have seen specimens from Nepaul that are precisely similar.—Starlings are often seen in company with rooks, pigeons, and jackdaws.

The *red-winged Starlings of America*, though generally migratory in the States north of Maryland, are found during winter in immense flocks, sometimes associated with the purple grakles, and often by themselves, along the whole lower parts of Virginia, both Carolinas, Georgia, and Louisiana, particularly near the sea coast, and in the vicinity of large rice and corn fields. In the months of January and February, (says Wilson,) while passing through the former of these countries, I was frequently entertained with the aerial evolutions of these great bodies of starlings. Sometimes they appeared driving about like an enormous black cloud carried before the wind, varying its shape every moment. Sometimes suddenly rising from the fields around me with a noise like thunder; while the glittering of innumerable wings of the brightest vermilion amid the black cloud they formed, produced on these occasions a very striking and splendid effect. Then descending like a torrent, and covering the branches of some detached grove, or clump of trees, the whole congregated multitude commenced one general concert or chorus, that I have plainly distinguished at the distance of more than two miles; and, when listened to at the intermediate space of about a quarter of a mile, with a slight breeze of wind to swell and soften the flow of its cadences, was to me grand, and even sublime. The whole season of winter, that, with most birds, is past in struggling to sustain life in silent melancholy, is, with the red-wings, one continued carnival. The profuse gleanings of the old rice, corn, and buckwheat fields, supply them with abundant food, at once ready and nutritious; and the intermediate time is spent either in aerial manœuvres, or in grand vocal performances, as if solicitous to supply the absence of all the tuneful summer tribes, and to cheer the dejected face of nature with their whole combined powers of harmony. Before the beginning of September, these flocks have become numerous and formidable; and the young ears of maize, or Indian corn, being then in their soft succulent, milky state, present a temptation that cannot be resisted. Reinforced by numerous and daily flocks from all parts of the interior, they pour down on the low countries in prodigious multitudes. Here they are seen, like vast clouds, wheeling and driving over the meadows and devoted corn fields, darkening the air with their numbers. Then commences the work of destruction on the corn, the husks of which, though composed of numerous envelopements of closely wrapt leaves, are soon completely or partially torn off; while from all quarters myriads continue to pour down like a tempest, blackening half an acre at a time; and, if not disturbed, repeat their depredations till little remains but the cob and the shrivelled skins of the grain; what little is left of the tender ear, being exposed to the rains and weather, is generally much injured. All the attacks and havoc made at this time among them with the gun, and by the hawks,—several species of which are their constant attendants,—has little effect on the remainder. When the hawks make a sweep among them, they suddenly open on all sides, but rarely in time to disappoint them of their victims; and, though repeatedly fired at, with mortal effect, they only remove from one field to an adjoining one, or to another quarter of the same inclosure. From dawn to nearly sunset, this open and daring devastation is carried on, under the eye of the proprietor; and a farmer, who has any considerable extent of corn, would require half-a-dozen men at least, with guns, to guard it; and even then, all their vigilance and activity would not prevent a good tithe of it from becoming the prey of the blackbirds. The Indians, who usually plant their corn in one general field, keep the whole young boys of the village all day patrolling round and among it; and each being furnished with bow and arrows, with which they are very expert, they generally contrive to destroy great numbers of them. To compensate their consumption of corn in autumn, their general food in spring, as well as during the early part of summer, consists of grub-worms, caterpillars, and various other larvæ, the silent, but deadly enemies of all vegetation, and whose secret and insidious attacks are more to be dreaded by the husbandman than the combined forces of the whole feathered tribes together. For these vermin, the starlings search with great diligence; in the ground, at the roots of plants, in orchards, and meadows, as well as among buds, leaves, and blossoms; and, from their known voracity, the multitudes of these insects which they destroy must be immense. Let me illustrate this (continues Wilson) by a short computation; If we suppose each bird, on an average, to devour fifty of these larvæ in a day (a very moderate allowance), a single pair, in four months, the usual time such food is sought after, will consume upwards of twelve thousand. It is believed, that not less than a million pair of these birds are distributed over the whole extent of the United States in summer; whose food being nearly the same, would swell the amount of vermin destroyed to twelve thousand millions. But the number of young birds may be fairly estimated at double that of their parents; and, as these are constantly fed on larvæ for at least three weeks, making only the same allowance for them as for the old ones, their share would amount to four thousand two hundred millions; making a grand total of sixteen thousand two hundred millions of noxious insects destroyed in the space of four months by this single species! The combined ravages of such a hideous host of vermin would be sufficient to spread famine and desolation over a wide extent of the richest and best cultivated country on earth. All this, it may be said, is mere supposition. It is, however, supposition, founded on known and acknowledged facts. I have never dissected any of these birds in spring without receiving the most striking and satisfactory proofs of these facts; and though, in a matter of this kind, it is impossible to ascertain precisely the amount of the benefits derived by agriculture from this, and many other species of our birds, yet in the present case, I cannot resist the belief, that the services of this species, in spring, are far more important and beneficial than the value of all that portion of corn which a careful and active farmer permits himself to lose by it.

American mock-bird, the favourite songster of a region, where the birds excel rather in the beauty of their plumage than the sweetness of their notes.

This valuable bird does not seem to vie with the feathered inhabitants of that country in the beauty of its plumage, content with qualifications that endear it to mankind much more. It is but a plain bird to the eye, about the size of a thrush, of a white and gray colour, and a reddish bill. It is possessed not only of its own natural notes, which are musical and solemn, but it can assume the tone of every other animal in the wood, from the wolf to the raven. It seems even to sport itself in leading them astray. It will, at one time, allure the lesser birds with the call of their males, and then terrify them, when they have come near, with the screams of the eagle. There is no bird in the forest but it can mimick; and there is none that it has not, at times, deceived by its call. But, not like such as we usually see famed for mimicking with us, and which have no particular merit of their own, the mock-bird is ever surest to please when it is most itself. At those times it usually frequents the houses of the American planters; and, sitting all night on the chimney-top, pours forth the sweetest and the most various notes of any bird whatever. It would seem, if accounts be true, that the deficiency of most other song-birds in that country, is made up by this bird alone. They often build their nests in the fruit-trees about houses, feed upon berries and other fruits, and are easily rendered domestic.[1]

[1] Wilson's description of the American *mocking-bird* is extremely animated; but, in his enthusiasm, he is supposed to have somewhat exaggerated the qualities of the little mimic. (See page 143, *ante*, *Note*.) "The voice of the mocking-bird," says the great American ornithologist, "is full, strong, and musical, and capable of almost every modulation, from the clear mellow tones of the wood-thrush to the savage scream of the bald eagle. In measure and accents he faithfully follows his originals, while in force and sweetness of expression he greatly improves upon them. In his native woods, on a dewy morning, his song rises above every competitor, for the others seem merely as inferior accompaniments. His own notes are bold and full, and varied seemingly beyond all limits. They consist of short expressions of two, three, or at most five or six syllables, generally expressed with great emphasis and rapidity, and continued with undiminished ardour, for half an hour or an hour at a time. While singing, he expands his wings and his tail, glistening with white, keeping time to his own music, and the buoyant gaiety of his action is no less fascinating than his song. He sweeps round with enthusiastic ecstasy, he mounts and descends as his song swells or dies away; he bounds aloft, as Bartram says, with the celerity of an arrow, as if to recover or recal his very soul, expired in the last elevated strain. A bystander might suppose that the whole feathered tribes had assembled together on a trial of skill; each striving to produce his utmost effect, so perfect are his imitations. He often deceives the sportsman, and even birds themselves are sometimes imposed upon by this admirable mimic. In confinement he loses little of the power or energy of his song. He whistles for the dog; Cæsar starts up, wags his tail, and runs to meet his master. He cries like a hurt chicken, and the hen hurries about, with feathers on end, to protect her injured brood. He repeats the tune taught him, though it be of considerable length, with great accuracy. He runs over the notes of the canary, and of the red bird, with such superior execution and effect, that the mortified songsters confess his triumph by their silence. His fondness for variety, some suppose to injure his song. His imitations of the brown thrush are often interrupted by the crowing of cocks; and his exquisite warblings after the blue bird, are mingled with the screaming of swallows, or the cackling of hens. During moonlight, both in the wild and tame state, he sings the whole night long. The hunters, in their night excursions, know that the moon is rising the instant they begin to hear his delightful solo. After Shakspeare, Barrington attributes in part the exquisiteness of the nightingale's song to the silence of the night; but if so, what are we to think of the bird which, in the open glare of day, overpowers and often silences all competition? His natural notes partake of a character similar to those of the brown thrush, but they are more sweet, more expressive, more varied, and uttered with greater rapidity."

CHAP. III.

OF THE NIGHTINGALE, AND OTHER SOFT-BILLED SONG-BIRDS.

The Nightingale is not only famous among the moderns for its singing, but almost every one of the ancients, who undertook to describe beautiful nature, has contributed to raise its reputation. "The nightingale," says Pliny, "that, for fifteen days and nights, hid in the thickest shades, continues her note without intermission, deserves our attention and wonder. How surprising that so great a voice can reside in so small a body! such perseverance in so minute an animal! With what a musical propriety are the sounds it produces modulated! The note at one time drawn out with a long breath, now stealing off into a different cadence, now interrupted by a break, then changing into a new note by an unexpected transition; now seeming to renew the same strain, then deceiving expectation! She sometimes seems to murmur within herself; full, deep, sharp, swift, drawling, trembling; now at the top, the middle, and the bottom of the scale! In short, in that little bill seems to reside all the melody which man has vainly laboured to bring from a variety of musical instruments. Some even seem to be possessed of a different song from the rest, and contend with each other with great ardour. The bird overcome is then seen only to discontinue its song with its life."

This most famous of the feathered tribe visits England in the beginning of April, and leaves us in August. It is found but in some of the southern parts of the country, being

totally unknown in Scotland, Ireland, or North Wales. They frequent thick hedges and low coppices, and generally keep in the middle of the bush, so that they are rarely seen. They begin their song in the evening, and generally continue it for the whole night. For weeks together, if undisturbed, they sit upon the same tree; and Shakspeare rightly describes the nightingale sitting nightly in the same place, which I have frequently observed she seldom departs from.[1]

From Pliny's description, we should be led to believe this bird possessed of a persevering strain; but though it is in fact so with the nightingale in Italy, yet, in our hedges in England, the little songstress is by no means so liberal of her music. Her note is soft, various, and interrupted; she seldom holds it without a pause above the time that one can count twenty. The nightingale's pausing song would be the proper epithet for this bird's music with us, which is more pleasing than

[1] The *Nightingale.*—"The nightingale, whose plumage is very ordinary, is scarcely five inches long, two



and a half of which belong to the tail. But in confinement, when it is well fed, and especially when it has been bred from the nest, it is commonly larger, reaching sometimes the size of a lark. When wild, nightingales are found throughout Europe, as far as the north of England, and the middle of Sweden; in all Asia, as far as the temperate regions of Siberia; and in Africa, on the banks of the Nile. They every where choose for their residence places which are shady, cool, but not cold, such as woods, thickets, and even mere hedges in the fields. Groves, thick brambles, tufted bushes near fields and meadows, are their favourite abodes. They also like gardens planted with untrimmed elm-hedges, which are consequently thick and bushy down to the ground. Their principal food is insects, especially green caterpillars, of which they clear the bushes and trees, butterflies, flies, and beetles, and the grubs of insects hid among moss or in the earth. At their departure, towards the end of summer, they also eat elderberries and currants. They build their nests in a grove or orchard, among a heap of branches, or in a thorn bush, or the trunk of a tree surrounded by briars. They are easily caught with limed twigs, or nooses and springs. When allowed to fly freely in rooms, they do not sing so well as in cages, which should be of an ordinary size, and formed of osiers.

The first good quality of a nightingale is undoubtedly its fine voice, and notes which I shall endeavour to describe. The nightingale expresses his different emotions by suitable and particular tones. The most unmeaning cry when he is alone appears to be a simple whistle *fitt*, but if the syllable *crr* is added, it is then the call of the male to the female. The sign of displeasure or fear is *fitt* repeated rapidly and loudly before adding the terminating *crr*; whilst that of satisfaction and pleasure, such, for example, as conjugal endearments, or, on the occasion of finding a delicate morsel, is a deep *tack*, which may be imitated by smacking the tongue. In anger, jealousy, rivalry, or any extraordinary event, he utters hoarse disagreeable sounds, somewhat like a jay or a cat. Lastly, in the season of pairing, when the male and female entice and pursue each other, from the top of a tree to its base, and thence again to the top, a gentle subdued warbling is all that is heard.

Nature has granted these tones to both sexes; but the male is particularly endowed with so very striking a musical talent, that in this respect he surpasses all birds, and has acquired the name of the king of songsters. The strength of his vocal organ is indeed wonderful; and it has been found that the muscles of his larynx are much more powerful than those of any other bird. But it is less the strength than the compass, flexibility, prodigious variety, and harmony of his voice, which make it so admired by all lovers of the beautiful. Sometimes dwelling for minutes on a strain composed of only two or three melancholy tones, he begins in an under voice, and swelling it gradually by the most superb crescendo to the highest point of strength, he ends it by a dying cadence; or it consists of a rapid succession of more brilliant sounds, terminated, like many other strains of his song, by some detached ascending notes. Twenty-four different strains or couplets may be reckoned in the song of a fine nightingale, without including its delicate little variations; for among these, as among other musicians, there are some great performers and many middling ones. This song is so articulate, so speaking, that it may be very well written. The following is a trial which I have made on that of a nightingale in my neighbourhood, which passes for a very capital singer:—

Tioû, tioû, tioû, tioû.
Spe, tiou, squa.
Tiô, tiô, tiô, tiô, tio, tio, tio, tix.
Coutio, coutio, coutio, coutio.
Squô, squô, squô, squô.
Tzu, tzu, tzu, tzu, tzu, tzu, tzu, tzu, tzu, tzi.
Corror, tiou, squa pipiqui.
Zozozozozozozozozozozozozo, zirrhading!
Tsissisi, tsissisisisisisisis.
Dzorre, dzorre, dzorre, dzorre, hi.
Tzatu, tzatu, tzatu, tzatu, tzatu, tzatu, tzatu, dzi.
Dlo, dlo, dlo, dlo, dlo, dlo, dlo, dlo, dlo.
Quio tr rrrrrrrr itz.
Lu, lu, lu, lu, ly, ly, ly, ly, liê, liê, liê, liê.
Quio, didl li lulylie.
Hagurr, gurr quipio!
Coui, coui, coui, coui, qui, qui, qui, qui, gai, gui, gui, gui.
Goll goll goll goll guia hadadoi.
Couigui, horr, ha diadia dill si!
Hezezezezezezezezezezezezezezeze couar ho dze hoi.
Quia, quia, quia, quia, quia, quia, quia, quia, ti.
Ki, ki, ki, io, io, io, iotiotio ki.
Lu ly li le lai la leu lo, didl io quia.
Kigaigaigaigaigaigaigaigaigaigai couior dzio dzio pi.

If we could understand the sense of these words, we should doubtless discover the expression of the sensations of this delightful songster. It is true that the nightingales of all countries, the south as well as the north, appear to sing in the same manner; there is, however, as has been already observed, so great a difference in the degree of perfection, that we cannot help acknowledging that one has a great superiority over another. On points of beauty, however, where the

the warbling of any other bird, because it is heard at a time when all the rest are silent.

In the beginning of May, the nightingale prepares to make its nest, which is formed of the leaves of trees, straw and moss. The nest being very eagerly sought after, is as cunningly secreted; so that but very few of them are found by the boys when they go upon these pursuits. It is built at the bottom of hedges, where the bushes are thickest and best covered. While the female continues sitting, the male at a good distance, but always within hearing, cheers the patient hour with his voice, and, by the short interruption of his song, often gives her warning of approaching danger. She lays four or five eggs; of which but a part in our cold climate come to maturity.

The delicacy, or rather the fame, of this bird's music, has induced many to abridge its liberty, to be secured of its song. Indeed, the greatest part of what has been written concerning it in our country consists in directions how to manage it for domestic singing; while the history of the bird is confined to dry receipts for fitting it for the cage. Its song, however, in captivity, is not so very alluring; and the tyranny of taking it from those hedges where only it is most pleasing, still more depreciates its imprisoned efforts. Gesner assures us, that it is not only the most agreeable songster in a cage, but that it is possessed of a most admirable faculty of talking. He tells the following story in proof of his assertion, which he says was communicated to him by a friend. "Whilst I was at Ratisbon," says his correspondent, "I put up at an inn, the sign of the Golden Crown, where my host had three nightingales. What I am going to repeat is wonderful, almost incredible, and yet is true. The nightingales were placed separately, so that each was shut up by itself in a dark cage. It happened at that time, being the spring of the year, when those birds are wont to sing indefatigably, that I was so afflicted with the stone, that I could sleep but very little all night. It was usual then about midnight, when there was no noise in the house, but all still, to hear the two nightingales jangling and talking with each other, and plainly imitating men's discourses. For my part I was almost astonished with wonder; for at this time, when all was quiet else, they held conference together, and repeated whatever they had heard among the guests by day. Those two of them that were most notable, and masters of this art, were scarcely ten feet distant from one another.

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senses are the judges, each has his peculiar taste. If one nightingale has the talent of dwelling agreeably on his notes, another utters his with peculiar brilliancy, a third lengthens out his strain in a particular manner, and a fourth excels in the silveriness of his voice. All four may excel in their style, and each will find his admirer; and, truly, it is very difficult to decide which merits the palm of victory. There are, however, individuals so very superior as to unite all the beauties of power and melody; these are generally birds of the first breed, which, having been hatched with the necessary powers, in a district well peopled with nightingales, appropriate what is most striking in the song of each, whence results this perfect compound, so worthy of our admiration. As the return of the males in spring always precedes that of the females by seven or eight days, they are constantly heard to sing before and after midnight, in order to attract their companions on their journey during the fine nights. If their wishes are accomplished, they then keep silence during the night, and salute the dawn with their first accents, which are continued through the day. Some persist in their first season in singing before and after midnight, whence they have obtained the name of nocturnal nightingales; but they cannot be distinguished till after some time, when they are established in their district, and have the society of their females. After repeated experiments for many successive years, I think I am authorised in affirming that the nocturnal and diurnal nightingales form distinct varieties, which propagate regularly: for if a young bird is taken from the nest of a night singer, he in his turn will sing at the same hours as his father, not the first year, but certainly in the following; while, on the other hand, the young of a day nightingale will never sing in the night, even when it is surrounded by nocturnal nightingales.

It is a pity that the time for this delightful bird's song should be so short, that is to say, when wild. It endures hardly three months; and during this short interval it is not maintained with equal power. At its first arrival it is the most beautiful, continued, and impassioned; when the young are hatched, it becomes more rare; the attentions which they require occupying considerable time. If from time to time the nightingale's song is heard, it is evident that the fire which animated it is much weakened. After midsummer all is ended, nothing is heard but the warbling of the young, which seem to study their father's song, and try to imitate it. The nightingale sings much longer in confinement: birds which are caught full grown sometimes sing from November to Easter; those which are bred from the nest sing much longer, sometimes as long as seven months; but in order that they may sing well, they must be put under the instruction of an old nightingale which is a good singer, otherwise they will be only stammerers, mutilating their natural song, and inserting in a confused manner tones and passages which they have caught from other birds. If, however, they have a good instructor, and a good memory, they imitate perfectly, and often add to their instructor's song some beauties of their own, as is usual among young birds.

Independent of these talents, the nightingale possesses a quality very likely to augment the number of his friends; he is capable, after some time, of forming attachments. When once he has made acquaintance with the person who takes care of him, he distinguishes his step before seeing him; he welcomes him by a cry of joy; and, during the moulting season, he is seen making vain efforts to sing, and supplying, by the gaiety of his movements, and the expression of his looks, the demonstrations of joy which his throat refuses to utter. When he loses his benefactor, he sometimes pines to death; if he survives, it is long before he is accustomed to another. His attachments are long, because they are not hasty, as is the case with all wild and timid dispositions."—*Bechstein on Cage Birds.*

The third hung more remote, so that I could not so well hear it as I lay a-bed. But it is wonderful to tell how those two provoked each other; and by answering, invited and drew one another to speak. Yet did they not confound their words, or talk both together, but rather utter them alternately and of course. Besides the daily discourse of the guests, they chaunted out two stories, which generally held them from midnight till morning; and that with such modulations and inflections, that no man could have taken to come from such little creatures. When I asked the host if they had been taught, or whether he observed their talking in the night, he answered, no: the same said the whole family. But I, who could not sleep for nights together, was perfectly sensible of their discourse. One of their stories was concerning the tapster and his wife, who refused to follow him to the wars, as he desired her: for the husband endeavoured to persuade his wife, as far as I understood by the birds, that he would leave his service in that inn, and go to the wars in hopes of plunder. But she refused to follow him, resolving to stay either at Ratisbon, or go to Nuremberg. There was a long and earnest contention between them; and all this dialogue the birds repeated. They even repeated the unseemly words which were cast out between them, and which ought rather to have been suppressed and kept a secret. But the birds, not knowing the difference between modest, immodest, honest, and filthy words, did out with them. The other story was concerning the war which the emperor was then threatening against the Protestants; which the birds probably heard from some of the generals that had conferences in the house. These things did they repeat in the night after twelve o'clock, when there was a deep silence. But in the day-time, for the most part they were silent, and seemed to do nothing but meditate and revolve with themselves upon what the guests conferred together as they sat at table, or in their walks. I verily had never believed our Pliny writing so many wonderful things concerning these little creatures, had I not myself seen with my eyes, and heard them with my ears uttering such things as I have related. Neither yet can I of a sudden write all, or call to remembrance every particular that I have heard."

Such is the sagacity ascribed to the nightingale; it is but to have high reputation for any one quality, and the world is ready enough to give us fame for others to which we have very small pretensions. But there is a little bird, rather celebrated for its affection to mankind than its singing, which, however, in our climate, has the sweetest note of all others. The reader already perceives that I mean the RED-BREAST, the well known



friend of man, that is found in every hedge, and makes it vocal. The note of other birds is louder, and their inflexions more capricious, but this bird's voice is soft, tender, and well supported; and the more to be valued, as we enjoy it the greatest part of the winter. If the nightingale's song has been compared to the fiddle, the red-breast's voice has all the delicacy of the flute.

The red-breast, during the spring, haunts the wood, the grove, and the garden; it retires to the thickest and shadiest hedge-rows to breed in.[1] But in winter it seems to be-

[1] The *Red-breast.*—The statement given in most books of natural history, that the red-breast, during summer, flies from the habitation of man, which he has haunted during the winter, to nestle in wild and solitary places, is far from being strictly correct. I readily admit that many of these birds may be found in woods and forests; but I am equally certain that a greater number do not go farther from their winter haunts than the nearest hedge-rows. Even in the near vicinity of London, in Copenhagen fields, Chelsea, Battersea fields, Peckham, wherever, indeed, there is a field and a few trees, I have heard red-breasts singing the whole summer. One has been in song all the summer, not a gun-shot from my house at Lee, where this paragraph was written; and I have remarked another singing for several months among some elms at Lewisham Bridge, though there are houses all round, and the bustle of the public road just below. The red-breast does not come, indeed, usually to the cottage for crumbs during summer, because then insects are plentiful; and this may have given rise to the common opinion. I once saw an instance, however, at Compton Basset, in Wiltshire, in which a red-breast made a daily visit, in summer, within a cottage door, to pick up what he could find. It is worthy of remark, that Graham's poetical sketch of the red-breast is much more true to nature than the statements of our professed naturalists:—

> "High is his perch, but humble is his home,
> And well conceal'd, sometimes within the sound
> Of heartsome mill-clack, where the spacious door,
> White-dusted, tells him plenty reigns around;
> Close at the root of brier-bush that o'erhangs
> The narrow stream, with shealings bedded white,
> He fixes his abode and lives at will.
> Oft near some single cottage he prefers
> To rear his little home; there, pert and spruce,
> He shares the refuse of the good wife's churn;
> Nor seldom does he neighbour the low roof
> Where tiny elves are taught."
>
> *Birds of Scotland.*

It is a constant inhabitant of the greater part of the European continent. About Barnholm, it is called Tomne-Leden; in Norway, Peter Ronsmad; in Ger-

come more domestic, and often to claim protection from man. Most of the soft-billed birds, the nightingale, the swallow, and the titmouse, leave us in the winter, when their insect food is no longer offered in plenty; but the redbreast continues with us the year round, and endeavours to support the famine of winter by chirping round the warm habitations of mankind; by coming into those shelters where the rigour of the season is artificially expelled, and where insects themselves are found in greater numbers, attracted by the same cause.

This bird breeds differently in different places: in some countries its nest is usually found in the crevice of some mossy bank, or at the foot of a hawthorn in hedge rows; in others it chooses the thickest coverts, and hides its nest with oak leaves. The eggs are from four to five, of a dull white, with reddish streaks.

The Lark, whether the sky-lark, the wood, or the tit-lark,[1] being all distinguishable from other little birds by the length of their heel, are louder in their song than either of the former, but not so pleasing. Indeed the music of every bird in captivity produces no very

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many, Thomas Gierdet; with us, Robin Red-breast and Ruddock.—*Rennie.*

[1] The song of the *Lark* is cheerful, and imparts a gaiety to the mind of even the most serious. His joyous matins and heavenward flight have been aptly compared to hymns and acts of adoration and praise. No bird sings with more method: there is an overture performed *vivace crescendo*, while the singer ascends; when at the full height, the song becomes *moderato*, and distinctly divided into short passages, each repeated three or four times over, like a *fantasia*, in the same key and time. If there be any wind, he rises perpendicularly by bounds, and afterwards poises himself with breast opposed to it. If calm, he ascends in spiral circles; in horizontal circles during the principal part of his song, and zigzagly downwards during the performance of the *finale*. Sometimes, after descending about half way, he ceases to sing, and drops with the velocity of an arrow to the ground. Those acquainted with the song of the sky-lark can tell without looking at them whether the birds be ascending or stationary in the air, or on their descent; so different is the style of the song in each case. In the first, there is an expression of ardent impatience; in the second, an *andante* composure, in which rests of a bar at a time frequently occur; and, in the last, a graduated sinking of the strains, often touching the subdominant before the final close. The time and number of the notes often correspond with the vibrations of the wings; and though they sometimes sing while on the ground, as they are seen to do in cages, their whole frame seems to be agitated by their musical efforts.

The *Crested-Lark* (so called from the tuft on its head) is pretty well spread throughout Europe, from Russia to Greece. It seems very doubtful, whether it is ever found in this country. It neither flies in flocks like the common lark, nor rises so high; and it continues in flight a longer time without alighting. It is by no means wild, nor does it dread the appearance of man, but commences to sing at his approach. The males sing infinitely better than the females, and their voice is very sweet and agreeable. During fine weather there is no cessation to their strains; but they become silent when the sky is overcast, and rain descends; they forget their gaiety and their music until the re-appearance of a brilliant sun re-animates their vivacity. They usually sing until the month of September. In captivity they also sing, and retain more readily the airs which are taught them from the bird-organ, than almost any other bird. But they seldom survive the loss of their liberty, and it requires much care and difficulty to preserve them any time in cages. The female places her nest on the ground, like the common species. She lays twice a year, about four or five eggs of a clear ash-colour, thick set with brown and blackish spots.

The *Wood-Lark* is smaller than the crested-lark, and



its tuft can hardly be considered as a genuine one, being only a little greater elongation of the feathers of the head than in the common lark. The male is more frequently observed to elevate these than this female. This lark is found in Germany, France, Holland, Siberia, Poland, and Italy. When these birds perch they sing agreeably. They are heard to warble in great numbers together, in the commencement of spring; but when these assemblages disperse in amorous couples, the male then displays all his vocal powers, and produces very melodious sounds, especially after sunset. In many respects, both of habit and appearance, these birds differ from the sky-lark. They perch as well in trees as on the ground; but this they do only on the largest branches, where they are able to secure their hold with positively embracing the stems with their toes. The sky-lark forms its nest amongst grass or corn; and the wood-lark usually at the foot of a bush, near the bottom of a hedge, or it lays where the grass is rank and dry. The fabric is of loose texture, and constructed of withered herbs and fibrous roots, with a few horse hairs in the inside.

The *Short-toed Lark* is met with in the Canaries, in the southern provinces of France, and especially in Champagne, where the species is remarkably numerous. This lark can run with the rapidity of a field mouse, especially when disturbed, and on the point of taking to flight. All the larks are pulverating birds; but this one is so particularly attached to powdering itself with dust, that, on being supplied with some in a state of captivity, it will immediately testify its joy by a little soft cry, frequently repeated, and by precipitate movements of the wings, and bristlings of all the feathers. It will plunge instantly into sand or ashes, as other birds do into water, remains there a long time, wallowing in all sorts of ways, and does not come out of it until it is so covered with it, that its plumage is scarcely to be distinguished.

The *Clapper Lark* is of South Africa. It usually makes its nest in some small grass, and lays from four to five eggs, of a greenish gray. It seldom rises more than from fifteen to twenty feet above the ground, and makes a particular noise, occasioned by the precipitate motion of its wings, which is heard at a great distance.

The *Red-backed Lark* chiefly delights in plains abounding with bushes. It perches readily on these,

pleasing sensations; it is but the mirth of a little animal, insensible of its misfortunate situation: it is the landscape, the grove, the golden break of day, the contest upon the hawthorn, the fluttering from branch to branch, the soaring in the air, and the answering of its young, that gives the bird's song its true relish. These, united, improve each other,

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and even on the trees which are at the edges of woods. Its song is agreeable.

The *Alpine Lark* inhabits the most northern portions of the two continents. In both quarters of the globe these larks, whose flesh is wholesome food, though without flavour, like that of most American birds, quit their winter retreat in the early days of spring, to withdraw into the countries which are nearest to the pole, where in perfect security from the aggressions of man, they may deliver themselves without disturbance to the education of their young families.

The *Calandre* is larger than the common lark, but yet has many points of resemblance to it, not only in conformation and colour, but also in habits and manners. It is found in the south of France, in Italy and the island of Sardinia, where it passes the entire year. The calandres are not observed to congregate in flocks, but usually remain single; in autumn they grow very fat, and are then good eating; they are taken in nets, laid near the waters where they are accustomed to drink.

The *Sirli*, a species of lark, is remarkable for its long and arched beak. It is found in the southern parts of Africa, and even in Barbary, usually inhabiting the sandy downs; from its peculiar song, which it generally puts forth from some little eminence, its name is derived.

The *Double-crested Lark* is distinguished chiefly by the double crest, from which its name is derived.

Titmice.—The majority of the *Titmice*, particularly those which frequent woods, thickets, and orchards, are courageous, and even ferocious; they will attack the owl with greater boldness than any other bird, being always foremost in darting on him, and trying to pick out his eyes. They express their little rage and fury by the swelling of their plumes, by violent attitudes, and precipitate motions; they peck sharply the hand which holds them, strike it repeatedly with the bill, and seem by their cries to call others to their assistance, which usually attracts them in crowds, and produces abundant sport to the fowler, for a single individual can take them all. There are many traits of conformity in their manners and disposition with those of the crows, shrikes, and pies; they have the same appetite for flesh, and the same custom of tearing their food in pieces to eat it. These birds being of a lively and active character, are incessantly in motion; they are continually fluttering from tree to tree, hopping from branch to branch, climbing up the trunk, crooking themselves to walls, and suspending themselves in all fashions, sometimes with the head downwards. Though fierce, they are social, seek out the company of their own species, and form little flocks, more or less numerous; and if any accident should separate them, they recall each other mutually, and are soon reunited. They then seek their food in common, visit the clefts of rocks and walls, and tear with their bills the lichens and the moss of trees, to find insects or their eggs. They also feed on seeds; but though in many species the bill is strong enough, they do not break them, like the bullfinches and linnets; they place them under their claws, and pierce them with their bills, like the nuthatches, with which they sometimes seem to associate during the winter. If a nut be suspended at the end of a string, they will hook themselves to it, and follow all its oscillations without letting go, and keep incessantly picking at it. Such manœuvres indicate much strength in the muscles; it has accordingly been observed that the bill is moved by very robust and vigorous muscles and ligaments, as well as the neck, and that the cranium is remarkably thick. They will eat not only grains, but insects, as above hinted, and butterfly-eggs, and peck the growing buds. The largest species (the great titmouse) joins to its other aliments bees, and even little birds, if it finds them enfeebled by illness, or entangled in snares, but it usually eats only the head. Almost all the species of titmice are very productive, even more so than any other birds, in proportion to their size; their brood is said sometimes to consist of eighteen or twenty eggs. Some make their nests in the trunks of trees, others on shrubs, and give it the form of a ball, of a volume greatly disproportioned to their size; some suspend it at the end of a branch, in reeds or rushes. The materials which they employ are small plants, little roots, moss, flax, cattle hair, wool, the down of plants, cotton, and feathers; they tend their numerous family with the most indefatigable zeal and activity, are very much attached to it, and defend it with courage against the birds which attack it. They rush on the enemy with such intrepidity as to force him to respect their weakness. The titmice are extended over the old continent, from the north to the south of Europe, through Africa, India, and China: they are also found in North America, but are as yet unknown in the southern part of that continent. Within these few years, several have been discovered in New Holland. Among the titmice, those which are most easily caught in snares, &c. are the great, the black, and blue-headed species; the crested, the long-tailed, the bearded, and the penduline are not so easily managed.

Buntings.—The *Buntings* are distinguished principally by their conical, short, and straight bill, and by the addition of a knob in the roof of the upper mandible, which is made use of by the bird as an anvil on which to break and comminute its food. This apparatus is sufficient to lead the observing naturalist *per saltum*, as it were, to the conclusion that this genus of birds must be granivorous. It is true, indeed, that very many birds are enabled to crack and open nuts and hard seeds, without the aid of that extra provision with which the buntings are furnished: and this is one of the countless instances which might be adduced to display the various means employed by Nature to attain one and the same end. How different, for instance, are the means by which the several classes of animals attain the common object of locomotion, and how various are the modifications of those means in the respective genera. The buntings, however, do not feed exclusively on vegetable matter; like most of their order, they subsist also partially on insects and worms.

The *Yellow Bunting* is known in England under the



name of *yellow hammer*; in Scotland under that of

and raise the mind to a state of the highest, yet most harmless, exultation. Nothing can, in this situation of mind, be more pleasing than to see the lark warbling upon the wing; raising its note as it soars, until it seems lost in the immense heights above us; the note continuing, the bird itself unseen; to see it then descending with a swell as it comes from the clouds, yet sinking by degrees as it approaches its nest, the spot where all its affections are centred, the spot that has prompted all this joy.

The lark builds its nest upon the ground, beneath some turf that serves to hide and shelter it. The female lays four or five eggs, of a dusky hue in colour, somewhat like those of a plover. It is while she is sitting that the male thus usually entertains her with his singing; and while he is risen to an imperceptible height, yet he still has his loved partner in his eye, nor once loses sight of the nest, either while he ascends or is descending. This harmony continues several months, beginning early in the spring on pairing. In winter, they assemble in flocks, when their song forsakes them, and the bird-catchers destroy them in great numbers for the tables of the luxurious.

The black-cap and the wren, though so very diminutive, are yet prized by some for their singing. The former is called by some the mock nightingale; and the latter is admired for the loudness of its note, compared to the little body from whence it issues. It must be confessed, that this disproportion between the voice of a bird and its size, in some measure demands our wonder. Quadrupeds in this respect may be considered as mutes to them. The peacock is louder than the lion, and the rabbit is not so loud as the wren. But it must be considered, that birds are very differently formed; their lungs in some measure are extended through their whole body, while in quadrupeds they lie only in the breast. In birds there are a variety of cells which take in the air, and thus pour forth

yellow-yeldring. The yellow on the crown of the head is sometimes replaced by olive-green: and this, as well as other occasional deviations from the ordinary gamboge yellow of this bird, would in all probability have induced the erroneous multiplication of species, had the yellow bunting and its incidents been less universally known. This bird builds in a careless manner, on the ground, or towards the bottom of a small bush. The exterior of the nest consists of straw, moss, dried leaves, and stalks; and within is a little wool. Notwithstanding the carelessness of its nidification, however, few birds display stronger attachment to the young and to their eggs, than this; so much so, as to be not unfrequently taken by the hand, on the nest, rather than abandon its offspring in time to save itself. The eggs are in general about five in number, and are whitish, with red streaks.

The *Foolish Bunting* frequents the warmer situations of Europe, and lives solitary in mountainous districts. It is said to have gained deservedly its epithet, from the ease with which it falls into every kind of snare.

The *Cirl Bunting* may be considered a British species, as it is not uncommon in company with the yellow bunting and the chaffinch on the southern coast of Devonshire. A straggler has been killed in Scotland.

The *Reed Bunting* is about the size of the yellow bunting, and is common in this country. It constructs its nest in grass or furze, near the ground, and has been said to attach it to three or four reeds above the water, whence its name. The eggs are four or five in number, bluish-white, spotted, and varied with brown.

The *Common Bunting* is rather larger than the yellow bunting, and is much less common here. While in France, they are merely occasional residents, and arrive there in the spring, from the south, shortly after the swallows, and quit that country again in the beginning of autumn, they are found here during the whole year, and congregate in winter in large flocks, when they are frequently caught in numbers, and sold under the name of bunting lark, ebbs, or corn bunting. They nestle on or near the ground, have four dirty-white eggs, spotted and streaked with brown; and the young have a reddish tinge. During incubation, the male is generally found perched on a branch not far distant from his mate, constantly uttering a tremulous kind of shriek, several times repeated with short intervals. Their unavailing anxiety to protect their eggs and young, frequently leads to the spot where they are deposited, which the simple birds are so unwilling to forsake, and, in their anxiety, so easily betray.

The *Ortolan Bunting* is never known to visit this country. This bird, whose flesh is very highly esteemed, and which is consequently much sought after, appears to be confined to the southern parts of Europe, where it is found at all seasons. When these birds first arrive in France, they are far from fat; but human ingenuity soon makes them fit for the table: they are fatted by inclosing a number of them in a dark chamber, in which is placed a lanthorn, surrounded plentifully with oats and millet. The darkness seems to have the effect of confining the whole attention of the birds to their favourite food, thus placed within view; and it is said they will thus die of suffocation from their own fat, if left entirely to themselves. Another mode is, by confining them in cages, which admit a little light only to the box containing the food. In this state, the ortolan bunting is said to be one of the most exquisite morsels known for the table.

Among the buntings, distinguished by an elongated claw to the thumb, is the *Snow Bunting*, as it is found in the northern parts of Great Britain, and is called in Scotland the *snow flake*. These birds appear there in large flocks, at the commencement of frost, and are feared by many as the harbingers of hard weather; they are about the size of the chaffinch, black above, with a white rump, crown, and forehead. They nestle in holes in rocks, and produce five white eggs, with dusky spots. They are found in all the northern latitudes, as high as navigators have penetrated; nor is it at all apparent by what means they find food in these inhospitable regions. The higher the degree of latitude in which they are found, the whiter, as it appears, becomes their plumage; this tendency, which we have had frequent occasion to notice, among the mammalia, as well as in the present class, has led to the conclusion that there are many varieties of this species. It breeds in Greenland, visits this country in harvest, and retires in spring. As the winter advances, it approaches the corn-yards, and feeds with the sparrows and finches. In Zetland it is called oat-fowl, from the preference which it gives to that kind of grain.

their contents at the little animal's command. The black-cap and the wren, therefore, are as respectable for their voices as they might be deemed inconsiderable for their size.[1]

All these soft-billed birds, thus prized for their singing, are rendered domestic, and brought up with assiduity by such as are fond of their voices in a cage. The same method

[1] The *Black-cap* is somewhat above five inches in length. It visits us about the middle of April, and retires in September; it frequents gardens, and builds its nest near the ground. The female lays five eggs, of a pale reddish brown, sprinkled with spots of a darker colour. During the time of incubation the male attends the female, and sits by turns; he likewise procures her food, such as flies, worms, and insects. The black-cap sings sweetly, and so like the nightingale, that in Norfolk it is called the mock nightingale. Black-caps feed chiefly on flies and insects, and not unfrequently on ivy and other berries.

The *Wren* is found throughout Europe. Its nest is



curiously constructed, being composed chiefly of moss, and lined with feathers; and in shape almost oval, with only one small entrance. This is generally found in some corner of an out-house, stack of wood, or hole in a wall, near our habitations; but when the wren builds in the woods, it is often in a bush near the ground, on the stump of a tree, or even with the ground. The female lays from ten to eighteen eggs.

The *Golden-Crested Wren* is said to be the smallest bird found in this kingdom, not weighing more than three drachms. It has an exceedingly beautiful small row of feathers on the top of the head, of a gold or orange colour, which it has a power of drawing together, in such a manner as entirely to conceal the little crest, by laying the feathers all flat upon the head; and likewise to raise them at pleasure. This is a beautiful, but rather rare bird; it is found in some of the woods near Oxford, also in Warwickshire, and several places in Wales: it has sometimes been seen in the southern parts of Scotland. The female lays six or seven very small eggs, not larger than peas, and feeds upon small insects.

The *Willow-Wren*.—This bird is little bigger than the common wren. It is migratory, visiting us annually about the middle of April, and taking its departure towards the end of September. The female constructs her nest in holes at the roots of trees, in hollows of dry banks, and other similar places. This is round, and not unlike that of the wren. The eggs are dusky white, and marked with reddish spots, and are five in number.

The *Wood-Wren* is a distinct species from the willow wren, with which it has been often confounded. It is distinguished by a more vivid plumage, and by frequenting natural woods and plantations. Among other birds belonging to this class may be mentioned the *Whitethroat*, the *Redtail*, and the *Greater* and *Lesser Pettychaps*.

Warblers.—The *Pensile Warbler* is nearly five inches long. The bill is dusky; the head grayish black; and the back deep gray. The sagacity displayed by this bird, in building and placing its nest, is truly remarkable. She does not fix it at the forking of the branches, as is usual with most other birds, but suspends it to binders hanging from the netting which she forms from tree to tree, especially those which fall from branches that hang over rivers and deep ravines. The nest consists of dry blades of grass, the ribs of leaves, and exceedingly small roots, interwoven with the greatest art; it is fastened on, or rather is worked into, the pendant strings. It is, in fact, a small bed rolled into a ball, so thick and compacted as to exclude the rain; and it rocks in the wind without receiving any harm. But the elements are not the only enemies against which this bird has to struggle; with wonderful sagacity it provides for the protection of its nest from other accidents. The opening is neither made on the top nor side of the nest, but at the bottom: nor is the entrance direct. After the bird has made its way into the vestibule, it must pass over a kind of partition, and through another aperture, before it descends to the abode of its family. This lodgment is round and soft, being lined with a species of lichen, which grows on the trees, or with the silky down of plants. The birds of this species have a very delicate song, which is continued throughout the year. They are natives of St Domingo, and some other of the West Indian islands, where they feed chiefly upon insects and fruit.

The *Superb Warbler*.—The general shape of this bird is very elegant; and though it has no variety of colours it is possessed of considerable beauty. The upper part of the body is blackish-blue, and white beneath. It is five inches and a half long, and inhabits New Holland.

Chats.—The *Chat* genus (which embraces the *White Ear*, the *Stone Chat*, and the *Whin Chat*) are all common in Europe, and frequent moors and other open wastes. They live solitary, or in pairs, and are wild in disposition. They run with much celerity, and their food consists of insects and worms, which they take chiefly upon the ground.

The *Winter Fauvette* is somewhat more than five inches. It is frequently seen in hedges, from which circumstance it has been called the hedge sparrow, but it has no other relation to the sparrow than in the dinginess of its colours; in every other respect it differs entirely. It remains with us the whole year, and builds its nest near the ground; it is composed of moss and wool, and lined with hair. The female generally lays four or five eggs, of a uniform pale blue, without any spots; the young are hatched about the beginning of May. During the time of sitting, if a cat or other voracious animal come near the nest, the mother endeavours to divert it from the spot by a stratagem similar to that by which the partridge misleads the dog: she springs up, and flutters from spot to spot, by which means allures her enemy to a safe distance. In France the hedge sparrow is rarely seen but in winter; it arrives generally in October, and departs in the spring for more northern regions where it breeds. It is supposed to brave the rigours of winter in Sweden, and that it assumes the white plumage common in these severe climates in that season. Its song is little varied, but pleasant, especially in a season when all other warblers are silent: its usual strain is a sort of quivering, frequently repeated something like the following *tit-tit titilit*; from which, in some places, it is called the titling.

Wagtails and Pipits.—All these birds frequent meadows, and humid and marshy places, delighting in the borders of rivulets and rivers. Most of them have an undulating flight. They all run rather than walk; seldom perch, sing, or cry, during the flight; and construct their nest on the ground. That of the white wagtail is, however, sometimes found in a pile of wood, alongside of the banks, or in the hole of some wall whose base is washed by waters. Insects and small worms are their only ali-

of treatment serves for all, as their food and their habits are nearly the same. The manner of taking and treating them, particularly the nightingale, is this: A nightingale's nest may be found by observing the place where the male sings, and then by sticking two or three meal-worms (a kind of maggot found in flour) on some neighbouring thorn, which when he sees he will infallibly bear away to his young. By listening, he then may be heard with the female chirping to the young ones while they are feeding. When the nest is found, if the young ones are not fledged enough to be taken, they must not be touched with the hands, for then the old ones will perceive it, and entice them away. They should not be taken till they are almost as full feathers as the old ones; and, though they refuse their meat, yet, by opening their bills, you may give them two or three small bits at a time, which will make them soon grow tame, when they will feed themselves. They should be put, nest and all, into a little basket, which should be covered up warm; and they should be fed every two hours. Their food should be sheep's hearts, or other raw flesh-meat, chopped very fine, and all the strings, skins, and fat, taken away. But it should always be mixed with hard hen's eggs, upon which they will feed and thrive abundantly.

They should then be put in cages like the nightingale's back cage, with a little straw or dry moss at the bottom; but when they are grown large, they should have ant's mould. They should be kept very clean, as indeed should all singing-birds whatsoever; for otherwise they will have the cramp, and perhaps the claws will drop off. In autumn they will sometimes abstain from their food for a fortnight, unless two or three meal-worms be given them twice or thrice a-week, or two or three spiders in a day; they must likewise

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ment. These insectivora, as useful as the fly-catchers and swallows, sometimes in the flight, but more frequently on the ground, amidst the herbage, seize upon the flies and gnats which have escaped the murderous bills of their other pursuers in the air. All the insect population of ponds and marshes constitute the nutriment of these volatiles. Their slight forms, little head, delicate feet, and long tails, perpetually balanced, cause them to be at once distinguishable from all other birds with slender bills.

The wagtails are not distrustful, and are less fearful of man than of the birds of prey. They are not even much frightened by fire-arms, for, on being aimed at, they do not fly far, and frequently return and place themselves within a short distance of the fowler. They give into all kinds of snares which are laid for them, quite easily; but if taken when adult, they cannot be preserved in cages, but will die in four-and-twenty hours. For this purpose, they must be taken from the nest, and reared like the nightingales. Of the species which frequent Britain are the Pied Wagtail, the Gray or Water Wagtail, and the Yellow Wagtail.

The *Pipits*, or *Field Larks*, have much analogy with those of the larks proper, though they differ in certain details of conformation. Like the larks, they sing in flying, and elevate themselves to a certain height in the air. They seek their nutriment, nestle, and sleep on the ground. Some frequent cultivated fields and meadows; others delight, during the summer season, in the borders of woods, in glades, in furze, and brushwood, thinly scattered; many prefer mountains, steep shores, rocks, and maritime pastures. Some few, in fine, inhabit, during summer, the little hills in sandy and stony situations, and during the after season, sojourn on the banks of rivers, and seek their food upon the strand. A very small number have the power of perching constantly upon trees. There is a considerable trouble in distinguishing them specifically. Of those common to Britain are the *Rock* or *Shore Pipit*, the *Meadow Pipit*, or *Tit*, and the *Tree Pipit*.

Bottle Tit or *Long Tailed Titmouse*.—This elegant little animal is about five inches and a half in length. The bill is very short, the head round and covered with rough erect feathers; it has a very long tail, whence its specific name. It is of a brownish colour, with black feathers, in the tail edged with white. It is most commonly found in low moist situations that are covered with underwood and interspersed with lofty oaks or elms. Its nest is generally placed in the forked branch of a large tree overhanging the water, and it lays from twelve to eighteen white eggs, spotted with rust colour at the larger end, which are smaller than those of any other British bird, with the exception of the golden-crested wren.

This bird, says Graves, "is almost incessantly in motion, running up and down the branches of trees in search of food, which consists of the smaller species of insects, also the larvæ and eggs of those that deposit them in the crevices of the bark. In the winter they associate in small flocks of from eight to twelve, and sometimes more, and are kept together by their continual chirping. Like the nest, their colours assimilate so nearly with the white moss, abundant on trees at that season of the year, that, were it not for their note, it would be difficult to find them. Owing to the length of its tail, its flight is undulating and irregular, but most usually very quick, seeming to pass through the air like an arrow." Jesse remarks that the bill becomes harder in the winter than in the summer, as it is then more worn in the act of obtaining food from the frozen ground and hard wood. The sight of this bird is remarkably acute. It flits with the greatest quickness among the branches of trees, and its food consists in a great measure of small insects only to be discerned with a microscope.

Its nest is one of the most delicate and curiously constructed of all those of our British birds. It is much in the form of a bottle (whence the provincial name of the bird has been derived), with an opening at the side near the top. The outer portion is composed of white and gray tree lichens, in minute pieces, intermixed with the egg-nests of spiders, which are composed of a kind of gossamer or down-like envelope, of a small size, but somewhat resembling the cocoon of a silk-worm, and are found attached to the branches of trees, &c., enclosing the eggs of the insect. A very interesting description is given of them in the volume on Insect Transformation in the "Library of Entertaining Knowledge." With these gossamer envelopes it joins and binds the different leaves and mosses forming the exterior of the nest; and when the filaments become loosened it has very much the appearance of having been worked with spiders'-webs, an opinion entertained by the early naturalists. The greater portion of the interior is formed of green mosses nicely felted together with fine wool, lined with a number of soft feathers, the upper part being composed of strong broad moss, so closely woven together as to be impervious to the wet.

have a little saffron in their water. Figs chopped small among their meat will help them to recover their flesh. When their legs are cramped, they should be anointed with fresh butter, or capon's fat, three or four days together. If they grow melancholy, put white sugar-candy into their water, and feed them with sheep's hearts, giving them three or four meal-worms in a day, and a few ants with their eggs.

With regard to adult birds, those that are taken before the twenty-third of April are counted the best, because after that they begin to pair. They usually haunt woods, coppices, and quickset hedges, where they may be taken in trap-cages baited with meal-worms. They should be placed as near the spot where the bird sings as possible; and before you fix the trap, turn up the earth twice the breadth of the cage, because they will there look for food. They are also taken with lime twigs, placing them upon the hedge where they usually sing; and there should be meal-worms stuck at proper places to draw them into the snare. After they are taken, their wings should be gently tied with thread, to prevent their beating themselves against the cage. This should be first hung in a private place, that the bird may not be disturbed; and it should be fed every two hours, at farthest, with sheep's hearts and eggs minced very fine, mixing it with meal-worms. However, the first food must be worms, ants, caterpillars, and flies. You must, to feed the bird, take it in your hand, and open the bill with a stick made thick at one end, giving it the insects, or four or five bits of food as big as peas, to entice it to eat. Its common food should be mixed with ants, so that when the bird goes to pick up the ants, it may pick up some of that also. The nightingale, when caged, begins to sing about the latter end of November, and continues its song till June.

CHAP. VI.

OF THE CANARY-BIRD, AND OTHER HARD-BILLED SINGING BIRDS.[1]

The Canary bird is now become so common, and has continued so long in a domestic state, that its native habits, as well as its native country, seem almost forgotten. Though by the name it appears that these birds came originally from the Canary islands, yet we have it originally from Germany, where they are bred up in great numbers, and sold into different parts of Europe. At what period they were brought into Europe is not well known; but it is certain that about a century ago they were sold at very high prices, and kept only for the amusement of the great. They have since been multiplied in great abundance: and their price is diminished in proportion to their plenty.

[1] The *Canary* is a delightful cage-bird, and is, unquestionably, one of the sweetest of singers. Its form is perfect in symmetry, and its hue "beautiful exceedingly," through all the varieties of yellow, white, black-



ish, and chestnut. The primitive race, as it came from the Canary isles, is supposed to have had the upper part of the body of a linnet brown, and the under part of a yellowish green, with dark-brown eyes. The little foreigner takes kindly to mates of another race, and hence the various species now in existence. With the goldfinch, the linnet, and the green-bird, in particular, the canary readily enters into the ties of wedlock. The nest which the canary builds is remarkable for its neatness: and when different materials are supplied to it for this end, it evinces great discrimination in selecting the best. The eggs are of a sea-green colour, spotted at one end more or less with maroon or violet. What the proper food for the canary is, has been the subject of much dispute. Dr Bechstein, in his work on cage-birds, has some excellent observations upon the head. Summer rapeseed he has found to answer best, mixing with it now and then, for the sake of variety, a little hempseed or canary. Green food, such as chickweed, is given in spring, and fresh water daily, both for drinking and bathing. All complicated mixtures of food are noxious, though too often used. Canaries not only have fine notes of their own, but are possessed of excellent memories, and repeat musical sounds which they hear, with ease and precision. Among the novelties exhibiting this season (1839) in London is a canary, which is said to articulate words as distinctly as a parrot. The manner of training them to the imitation of instruments, or the whistling of tunes, is thus described by Bechstein:—"No sooner have the young canaries reached the thirteenth or fourteenth day, than they begin to warble; and as these pretty birds are so docile as to neglect entirely their natural song, and imitate the harmony of our instruments, it is necessary immediately to separate from his companions, and from every other bird, the young one which is to be instructed, by putting him aside in a cage which is at first covered with a piece of linen, and afterwards with a darker cover. The air which is to be taught should be performed five or six times a-day, especially in the evening and morning, either by whistling or on a flageolet or bird-organ; he will acquire it more or less readily in from two to six months, according to his abilities and memory; if his separation from the other birds is delayed beyond the fourteenth day, he will retain some part of his father's song, which he will always intermingle with his acquired air, and consequently never perform it perfectly."

In its native islands, a region equally noted for the beauty of its landscapes and the harmony of its groves, the canary bird is of a dusky gray colour, and so different from those usually seen in Europe, that some have even doubted whether it be of the same species. With us, they have that variety of colouring usual in all domestic fowls; some white, some

The *Bullfinch* is another of our finest cage-birds. His beautiful velvet black head and chin, his deep vermillion



neck and breast, and his dark gray back and shoulders, conjoined with the strength of his make, and full rounded appearance, render the bullfinch a favourite with all bird-fanciers. It is besides a bird of a peculiarly strong affection, and can hardly endure life when absent from its mate. Unfortunately, they do not breed well in confinement. In the wild state, the female, twice a-year, lays from three to six eggs, of a bluish-white colour, and spotted with violet and brown at the large end. In feeding bullfinches, it has been found that they thrive particularly well when the rapeseed is given to them soaked in water. This bird, which can be trained to a high degree of perfection in singing, is fortunately one of the most easy to be procured. A decoy, or any of the common modes of snaring, effects his capture at once, when his haunt is discovered. Regarding his vocal powers, Bechstein remarks:—"Although the song of the male and female bullfinch, in their wild state, is very harsh and disagreeable, yet, if well taught while young, as they are in Hesse and Fulda, where there are schools of these little musicians, for all Germany, Holland, and England, they learn to whistle all kinds of airs and melodies with so soft and flute-like tone, that they are great favourites with amateurs, and particularly with the ladies. There are some of these little birds which can whistle distinctly three different airs, without spoiling or confusing them in the least. Added to this attraction, the bullfinch becomes exceedingly tame, sings whenever it is told to do so, and is susceptible of a most tender and lasting attachment, which it shows by its endearing actions; it balances its body, moves its tail from right to left, and spreads it like a fan. It will even repeat words, with an accent and tone which indicates sensibility, if one could believe that it understood them; but its memory must not be overloaded. A single air, with a prelude or a short flourish to begin with, is as much as the bird can learn and remember, and this it will execute to the greatest perfection. These little prodigies would be more interesting and agreeable, if their Hessian instructors possessed a little musical taste, but these are generally trades-people, employed about the house with their different occupations and trades; and hymns, airs, minuets of a hundred years old, and public-house songs, in general compose the whole of their music. This, however, is not the little bird's fault. The bullfinch can also imitate the songs of other birds: but in general it is not permitted to do so, that it may only learn to repeat the airs which are taught it. Different degrees of capacity are shown here, as well as in other animals. One young bullfinch learns with ease and quickness, another with difficulty and slowly; the former will repeat, without hesitation, several parts of a song; the latter will be hardly able to whistle one, after nine months uninterrupted teaching. But it has been remarked that those birds which learn with most difficulty, remember the songs which have once been well learnt, better and longer, and rarely forget them, even when moulting. Tame bullfinches have been known (says Buffon) to escape from the aviary, and live at liberty in the woods for a whole year, and then to recollect the voice of the person who had reared them, return to her, never more to leave her. Others have been known, which, when forced to leave their first master, have died of grief. These birds remember very well, and often too well, any one who has injured them. One of them having been thrown down, with its cage, by some of the lowest order of people, did not seem at first much disturbed by it, but afterwards it would fall into convulsions as soon as it saw any shabbily dressed person, and it died in one of these fits eight months after the first accident. A bullfinch, belonging to a lady being subject to very frightful dreams, which made it fall from its perch, and beat itself in the cage, no sooner heard the affectionate voice of its mistress, than notwithstanding the darkness of the night, it became immediately tranquil, and re-ascended its perch, to sleep again. It was very fond of chickweed, and as soon as it perceived one bringing it to him, however much care was taken to prevent its finding it easily, it would show its joy by its actions and cries."

The *Chaffinch* is one of the sprightliest warblers of spring. It is black in the forehead, grayish-blue on the



top of the head and nape of the neck; the back is of a linnet-green, and the whole under part of the body of reddish chestnut brown; the quill feathers are black, edged with white on the outer side, while the tail is almost pure black. Such is the chaffinch; that is to say, the male bird; for the male being always preferred for singing qualities, it is that sex which we have preferred throughout to describe. The nest of the chaffinch is a model of ingenuity. The female deposits in it, twice a-year, from three to five eggs, of a pale bluish-gray, spotted and streaked with brown. Young chaffinches are exceedingly quick in the ear; and if it is intended to train them to artificial song, they must be removed from the nest as soon as the tail-feathers begin to appear. As to their food, they should be treated much in the same way as the birds already noticed, with the addition of insects to their diet, in accordance with their diet in the wild state. Rapeseed soaked in water, and the crumbs of white bread, will be the proper food for young birds taken early from the nest for the purpose of training. In Germany, the song of the chaffinch is admired almost to idolatry, and, in truth, its clear and trilling tones approach much more closely to articulate sounds than the notes of any other bird. The Germans have distinguished the most admired variations of the chaffinch's strains by different names, expressive of a fanciful mean

mottled, some beautifully shaded with green; but they are more esteemed for their note than their beauty, having a high piercing pipe, as indeed all those of the finch tribe have, continuing for some time in one breath without intermission, then raising it higher and higher by degrees, with great variety.

It is this that has rendered the canary bird,

ing attached to the sounds. Dr Bechstein mentions the Wine song, the Bridegroom's song, the Rider's song, and several others, which are, no doubt, in a great measure, the result of the art employed in the education of the bird, being perfect as pieces of music. That the chaffinch should be able to execute such things, however, indicates the possession of very superior capabilities. "Indeed," says Dr Bechstein, "the chaffinch has so great a facility in learning, that it not only imitates perfectly the song of another chaffinch near which it has been placed from youth, but being hung near a nightingale or canary, it learns several parts of their songs, and would no doubt give them completely, if its larynx were so formed that it could render notes so long and sustained; in fine, a great difference in memory is observed in these birds, as well as in all others of the singing species. Some require six months to learn an air that others catch on first hearing, and can repeat almost immediately; these can scarcely retain one of the songs given above; those can imitate three, four, and, should you wish it, five different ones. There are also some that cannot give one song without a fault, and we find others that will add to it, perfect it and embellish it. One thing peculiar to chaffinches, is the necessity of teaching them their song every year, and this in the manner proper for them, during the four or five weeks this exercise lasts. They first utter a murmur, or weak warbling, to which they add, at first in an under voice, one or two, and afterwards several syllables of their song; they are then said to *record*. A chaffinch that takes only a week or a fortnight to repeat this lesson for fully bringing out its voice, is reckoned among the geniuses of its species. It is known that other birds whose power of singing is confined to a particular season, also warble feebly, and mingle with their warbling some foreign notes, especially harsh and confused sounds; but none produce sounds so peculiar, and that have so little relation to their own song. If we pay a little attention, however, we shall find that this exercise is intended less to awaken the memory than to render the throat, stiffened by a tolerable long state of inaction, more pliant, and to bring back its natural flexibility."

The *Goldfinch* is one of the best known, and most



beautiful of our native birds. The seed of the thistle is its favourite food, hence its French name *(Chardonneret)* is derived. It is also sometimes called, in our language, the *Thistle-finch*. The fowlers, accordingly, who lay various snares for these birds, make use of thistle-seed as their bait. Though the goldfinches do not construct their nests until the middle of spring, they have yet three broods, the last of which takes place in August. The young cannot suffice for themselves for some time, even after quitting the nest; accordingly there is much patience requisite to rear them artificially. The best are said to be those which are born in thorny bushes and belong to the last brood. They are, it is said, more gay, and sing better than the others. The goldfinch is very easily reconciled to captivity, and even becomes quite familiar. From its activity and docility it may be taught a wonderful degree of precision in its movements; it will counterfeit death, and perform a great variety of other movements with the greatest dexterity; it can be taught to fire a cracker, and draw up small cups, containing its food and drink. Some years ago, the Sieur Roman exhibited in this country the wonderful performances of his birds. These were goldfinches, linnets, and canary birds. One appeared dead, and was held up by the tail, or claw, without exhibiting any signs of life. A second stood on its head, with its claws in the air. A third imitated a Dutch milkmaid going to market, with pails on her shoulders. A fourth mimicked a Venetian girl, looking out at a window. A fifth appeared as a soldier, and mounted guard as a centinel. The sixth was a cannonier, with a cap on its head, a firelock on its shoulder, and a firelock in its claw, and discharged a small cannon. The same bird also acted as if it had been wounded; it was wheeled in a little barrow, to convey it (as it were) to the hospital, after which it flew away, before the company. The seventh turned a kind of wind mill; and the last bird stood in the midst of some fire-works, which were discharged all around it, and this without exhibiting the least sign of fear. The goldfinch, naturally active and laborious, is fond of occupation in its prison, and if it has not some poppy-heads, hemp-stalks, and those of lettuce, to peck, for the purpose of keeping it in action, it will remove every thing that it finds. A single goldfinch, in an aviary where canaries are hatching, if he be without a female, is sufficient to make all the broods fail; he will fight with the males, disturb the females, destroy the nests, and break the eggs. These birds, however, though so lively and petulant, live in peace with each other, excepting a few quarrels about the perch and their food; all of them try to get possession of the highest perch in the aviary, for the purpose of sleeping, and the first who obtains it will not suffer the others to approach. It is necessary to place all the perches at a similar height, to isolate each from the other, and make every one only of length sufficient for a single bird. The mules from the goldfinch and canary are more robust than the latter, and live longer. Their song is also more brilliant; but Buffon says, that they imitate airs with difficulty. Others, on the contrary, pretend that they can very easily be taught by the bird-organ and flageolet. These mules resemble the male in the form of the bill, and the colours of the head and wings, and the female in the rest of the body. Some beautiful varieties result from this alliance. In autumn the goldfinches assemble together, live, during winter, in numerous flocks, and frequent those places where thistles and wild endive grow. During the severe cold, they shelter themselves in thick bushes; but they seldom recede far from the place where their food is found. Sometimes they mingle with other granivorous birds. Hempseed is the grain given to familiarize them with the cage; but it would be better to mingle millet and rape-seed with it, and to vary their aliment; thus the maladies might be avoided which attack them in captivity. The species of the goldfinch is extended throughout the whole of Europe nearly, and through some parts of Asia and Africa. Few species present more varieties than this; besides those which proceed from forced alliances, there are others attributable to aliment, to age, and to domestication. There is one which is white where the others are red, namely, on the

next to the nightingale, the most celebrated songster; and as it is more easily reared than any of the soft-billed birds, and continues its song throughout the year, it is rather the most common in our houses. Rules, therefore, have been laid down, and copious instructions given, for breeding these birds in a domestic state; which, as a part of them may conduce towards

forehead and eyebrows, which colour also prevails on the top of the head, instead of black. On some the red is shaded with yellow, and the black appears through these colours. A goldfinch, with the head striped with red and yellow, has been found in America. One with the cap altogether black has but a few red spots on the forehead; the back and chest are of a yellowish brown; the iris yellowish, and the bill and feet flesh-colour. The whitish goldfinch has the tail and wings of an ashen brown, the upper and under parts of the body whitish, and the yellow of the wings pale. Some varieties are totally white, and others, among which are the handsomest races, have the head red and the wings bordered with yellow. On the bodies of many the tints are more or less mingled with white. Among the black goldfinches some are entirely black; others more or less varied with this colour. These last varieties are chiefly attributable to food, especially to the exclusive use of hempseed.

The *Linnet.* Several naturalists have made two species of the linnet, properly so called, under the denominations of *gray* and *red*; others have no doubt of the identity of the red and gray linnet; and this opinion is confirmed by repeatedly multiplied and indefatigable observations. Both kinds, young and old male and



female, are gray in the back season, and resemble each other so much, that the sexes cannot be distinguished, except by the white border on the primary alar quills, which is more broad and brilliant in the male than in the female. The red colour, which characterizes the male during summer, commences to appear towards the end of autumn; but at this time it is tarnished, and occupies only the middle portion of the feathers, the extremity of which is of a reddish gray, so that it can only be perceived by raising them up. In proportion as the spring approaches, this colour extends and grows brighter, and towards the month of May becomes very brilliant in the male of two years old; less pure and less extended in the bird of the first year; and among the old ones it sometimes assumes an orange shade. Of course, the linnets which remain gray must be only females; and it does not appear that any well-authenticated instance of a male of this hue at such periods has been found. There is a great analogy between the linnet and the canary. Their habits and nature are extremely similar, and of all birds the linnet is that which most readily couples with the canary. Although the linnet is one of the commonest of our small granivorous birds, and though it preserves no brilliant colours in captivity to render its possession desirable, it is not less in request than the brilliant goldfinch and charming bullfinch. Its natural disposition is docile, and susceptible of attachment; its song is agreeable, and the flexibility of its throat enables it to imitate with facility the different airs which it is attempted to be taught. It can even be taught to repeat many words distinctly, in different languages, and it pronounces them with an accent that would actually lead one to suppose that it understood their meaning. The tender attachment of which these birds are susceptible is astonishing; so much so, that they often become troublesome in their caresses. They can perfectly well distinguish the persons who take care of them. They will come and perch upon them, overwhelm them with caresses, and even seem to express their affection by their looks. They can also imitate and unite to the varied modulations of their own voice, the strains of other birds, which they are in the habit of hearing. If a very young linnet be brought up with a chaffinch, a lark, or a nightingale, it will learn to sing like them. But it will in most cases totally lose its native song, and preserve nothing but its little cry of appeal. The linnets intended to be instructed in foreign strains, should be taken from the nest when the feathers begin to shoot. If taken adult, they will seldom profit by their lessons, though they will become both familiar and caressing. Different modes of instruction have been pointed out for them—such as whistling to them in the evening by candle light, taking care to articulate the notes distinctly. Sometimes, to put them in train, they are taken on the finger, a mirror is presented to them in which they think that they see another bird of their own species, which illusion is said to produce a sort of emulation, making them sing with more animation, and expediting their progress; but these precautions are not absolutely necessary, for the best instructed linnets are often brought up by cobblers, who whistle to them without interrupting their work. It has been remarked of the linnets, and it is true of many other singing birds, that they sing more in a small cage than a large one. This bird lives a long time in captivity, if well taken care of. Sonnini quotes an instance of one that lived forty years, and might have lived longer had it not perished by accident. This was a bird of the most extraordinary amiableness and docility. It was in the habit of calling many persons of the house by their name, and very distinctly. It whistled five airs perfectly, from the bird-organ. The linnets have the advantage of singing all the year round, and they may be taught a variety of tricks, like the siskin, and the goldfinch. The nest of the linnet is generally built in furze, or some other low bush, and is formed of moss and stalks of grass interwoven with wool, and lined with hair and feathers. In winter linnets assemble in large flocks, and descend to the sea-coasts, where they continue to reside, till spring again urges them to pair and seek their upland haunts. They feed upon the seeds of flax, thistle, dandelion, &c.

The *Siskins* are birds of passage, and fly so high that they may be heard before they are seen. They are very numerous in the southern provinces of Russia, and common enough in this country during the winter; they are fond of places where the alder-tree abounds. They arrive in France about the time of the vintage, then proceed farther south, and re-appear when the trees are in flower; but in summer they are not seen. In all probability they then voyage northwards, or return into thick forests on the lofty mountains. The siskins, in their habits, have very considerable relations with the linnet: they give a preference to the seeds of the alder-tree; they often dispute with the goldfinches for the seed of the thistle. Hempseed is for them an aliment of

the natural history of the bird, I will take leave to transcribe.

In choosing the canary bird, those are best that appear with life and boldness, standing upright upon the perch like a sparrow-hawk, and not apt to be frighted at every thing that stirs. If its eyes look cheerful, and not drowsy, it is a sign of health; but, on the contrary, if it hides its head under the wing, and gathers its body up, these are symptoms of its being out of order. In choosing them, the melody of the song should also be minded; some will open with the notes of the nightingale, and, running through a variety of modulation, end like the tit-lark. Others will begin like the sky-lark, and, by a soft melodious turn, fall into the notes of the nightingale. These are lessons taught this bird in its domestic state, and generally taught it by others; but its native note is loud, shrill, piercing, and enough to deafen the hearers. There are persons who admire each of these songs, but the second is in the most general estimation.

Canary birds sometimes breed all the year

choice; but they appear, especially in captivity, to be greater consumers of it than they really are, from a habit which they have got of breaking more grains than they eat. In their passage in Germany, in October, they considerably damage the hop-grounds, by eating the seeds. In France, also, they do considerable prejudice to the apple-trees, by picking at the flowers. The song of the siskin is by no means disagreeable, but very inferior to that of the goldfinch: it is said to possess the faculty of imitating the song of the canary, linnet, &c. if taken very young, and placed within hearing of these birds, it has, moreover, a note of appeal peculiar to itself. Even when taken adult, it is easily tamed, and becomes almost as mild as a canary.

The *Citril Finch* is found in all Italy, Greece, Turkey, Austria, Provence, Languedoc, Spain, Portugal, and sometimes in Lorraine. The male has an agreeable and varied song, but not so fine and clear as that of the canary. In Italy this species makes its nest not only in the country, but oftentimes in gardens on tufted trees, particularly on the cypress, and constructs it of wool, horse hair, and feathers. The eggs are four or five: the male easily pairs with the female canary, and the mules have been found productive. The Count de Riocourt had for many years several of these mules, which coupled with female canaries, and the young produced new generations. The siskin, the goldfinch, and the linnet, are those respecting which the production of the female with the male canary is best authenticated. If mules are desired from these birds, they must be taken on the nest, brought up by hand with the canaries, fed on the same aliment, and kept in the same aviary. The goldfinch, for example, which is generally chosen in preference, should be kept from hempseed, and accustomed, as soon as he is able to eat alone, to millet and rape-seed, the ordinary food of the canaries. Without this, a risk is run of losing one or the other, in changing their diet. If hempseed be suddenly taken from a goldfinch accustomed to it, to give him the ordinary food of canaries, the change will make him ill, and may cause his death. If, on the contrary, you leave him the hempseed, the female canary will eat so much of it, that she will get a fever, and probably die. What is said of the goldfinch is applicable to all other birds destined for the same purpose. It is also recommended, in the case of the goldfinch, to cut the extremity of his bill dexterously, for about the thickness of a halfpenny, or not quite so much. If some drops of blood should follow, there is no occasion for apprehension. It may be stanched with a little saliva, mixed with pulverized sugar. This operation, however, should only be performed on those goldfinches whose bill is very pointed, which often happens in captivity. This is absolutely necessary, because this bird, pursuing the female, may wound her with his sharp bill, and prick the little ones in disgorging to them their food, which will destroy them. This inconvenience never takes place with goldfinches at liberty, for their bills are never so pointed, as the bills of the caged birds. If a female goldfinch is paired with a male canary, she should be two years old, for it is seldom that she lays in the first year. These birds, naturally wild, should be rendered as tame and familiar as the canaries, which may be accomplished by putting them in a low place, where there is plenty of company. It must not be imagined that all the mules which result from this alliance will be handsome. Of some, the plumage is of a very common kind, and the song very inferior. It would be useless to give any description of them, for they vary, *ad infinitum*, and no description would suit any but the individual described. It is sufficient to say, that it is constantly observed that the mules resulting from these mixtures resemble the father in the head, tail, and limbs, and the mother in the rest of the body; and that the mules which come from the male linnet and female canary, have neither the white colour of the mother, nor the red of the father, as some have pretended. The union of canaries with siskins, whether males or females, requires less attention. It is enough to let loose one or many of these birds, but always of the same sex, in a chamber, or large aviary, with canaries, and they will soon be seen to couple. We have said, of the same sex, because when the sexes are different the birds will naturally prefer their own species. The goldfinch, on the contrary, will only pair with the canary in a cage; to the linnet, greenfinch, and bullfinch, the cage and the aviary are indifferent. The commonest mules are produced from the linnet, the greenfinch, and the siskin, and the most esteemed of these, for song and beauty, are those from the male canary and a strange female. The mules from the greenfinch are in general of a bluish colour, and the males sing very badly, especially if the father be a greenfinch. The male mules from a linnet sing much better, but their plumage is very ordinary. Those of the siskin are small, and sing badly. Those from the bullfinch are susceptible of a perfect education, and their plumage is singular; but this alliance rarely thrives. The male feeds, it is true, like the canary, and pays much attention to the female. But she dislikes and flies from him. His cry, and the opening of his wide bill, frightens her. It is necessary to choose a vigorous female or male, which has been brought up with bullfinches, and has never coupled with a bird of its own species.

The *Mountain-finch* or *Brambling* is a native of northern climates, where it spreads into various parts of Europe: it arrives in this country in the latter end of summer, and is the most common in the mountainous parts of our island. Vast flocks of them sometimes come together; they fly very close, and on that account great numbers of them are frequently killed at one shot. The length of this bird is somewhat above six inches. Bill yellow at the tip; eyes hazel; the feathers on the head, neck, and back, are black, edged with rusty brown; sides of the neck, just above the wings, blue ash; rump white; the throat, fore-part of the neck, and breast, are of a pale orange; belly white; lesser wing-coverts black, tipped with pale yellow; quills dusky, with pale yellowish edges; the tail is forked, the outermost feathers edged with white, the rest black, with whitish edges; legs pale brown.

round; but they most usually begin to pair in April, and to breed in June and August. Those are said to be the best breeders that are produced between the English and the French.

Towards the latter end of March, a cock and a hen should be put together in a small cage where they will peck at each other in the beginning, but will soon become thoroughly reconciled. The room where they are kept to breed should be so situated as to let the birds have the benefit of the morning sun, and the windows should be of wire, not glass, that they may enjoy the benefit of the air. The floor of the room should be kept clean, and sometimes there should be dry gravel or sand sifted upon it. There should also be two windows, one at each end, and several perches at proper distances for the birds to settle on, as they fly backwards and forwards. A tree in the middle of the room would be the most convenient to divert the birds, and sometimes to serve for building their nests upon.

In Germany they prepare a large room, and build it in the manner of a barn, being much longer than broad, with a square place at each end, and several holes to go into those square places. In those outlets they plant several sorts of trees, in which the birds take great delight to sing and breed. The bottom of the place they strew with sand, and upon it cast rape-seed, chick-weed, and groundsel, which the old birds feed upon while breeding. In the body of the house they put all sorts of stuff for building the nest, and brooms, one under the other, in all the corners, for the birds to build in. These they separate by partitions from each other, to prevent those above flying down upon, or otherwise incommoding, such as breed below. The light also is excluded, for no bird is fond of having light come to its nest.

With us the apparatus for breeding is less expensive; a little breeding-cage sometimes suffices, but seldom any thing more extensive than a small room. While the birds are pairing, it is usual to feed them with soft meat; that is, with bread, maw-seed, a little scalded rape-seed, and near a third part of an egg. The room should be furnished with stuff for making their nests; such as fine hay, wool, cotton, and hair. These materials should be thoroughly dry, and then mixed and tied together in such a manner that the birds may readily pull out what they want. This should be hung in a proper part of the room, and the male will take his turn in building the nest, sitting upon the eggs, and feeding the young. They are generally two or three days in building their nests; the hen commonly lays five eggs: and in the space of fourteen days the young will be excluded. So prolific are these birds sometimes, that the female will be ready to hatch a second brood before the first are able to quit the nest. On these occasions she leaves the nest and the young, to provide herself with another to lay her new brood in. In the mean time the male, more faithful to the duties of his trust, breeds up the young left behind, and fits them for a state of independence.

When the young ones are excluded, the old ones should be supplied with a sufficiency of soft food every day, likewise with fresh greens, such as cabbage, lettuce, and chick-weed; in June, shepherd's purse; and in July and August, plantain. They are never to have groundsel after the young are excluded. With these different delicacies the old ones will take particular care to feed and bring up their young; but it is usual when they can feed themselves, to be taken from the nest and put into cages. Their meat then is the yolk of an egg boiled hard, with an equal quantity of fine bread, and a little scalded rape-seed: this must be bruised till it becomes fine, and then it may be mixed with a little maw-seed; after which blend all together; which is to be supplied them fresh every day.

The canary bird, by being kept in company with the linnet or the gold-finch, pairs and produces a mixed breed more like the canary bird, and resembling it chiefly in its song. Indeed, all this tribe with strong bills and piercing notes, and feeding upon grain, have the most strong similitude to each other, and may justly be supposed, as Mr Buffon imagines, to come from the same original. They all breed about the same time; they frequent the same vegetables; they build in the same hedges and trees; and are brought up for the cage with the same food and precautions. The linnet, the bullfinch, and the goldfinch, when we know the history of the canary bird, have scarcely any peculiarities that can attract our curiosity or require our care. The only art necessary with all those that have no very fine note, is to breed them up under some more pleasing harmonist. The goldfinch learns a fine song from the nightingale; and the linnet and bullfinch may be taught, forgetting the wild notes of nature, to whistle a long and regular tune.

CHAP. V.

OF THE SWALLOW, AND ITS AFFINITIES.

An idea of any one bird in the former classes will give us some tolerable conception

of the rest. By knowing the linnet or the canary bird, we have some notion of the manners of the goldfinch; by exhibiting the history of the nightingale, we see also that of the black-cap or the tit-mouse. But the swallow tribe seems to be entirely different from all the former; different in their form, different in their habits, and unlike in all the particulars of their history.

In this tribe is to be found the goat-sucker, which may be styled a nocturnal swallow; it is the largest of this kind, and is known by its tail, which is not forked, like that of the common swallow. It begins its flight at evening, and makes a loud singular noise, like the whur of a spinning-wheel. To this also belongs the house-swallow, which is too well known to need a description: the martin, inferior in size to the former, and the tail much less forked; it differs also in its nest, which is covered at top, while that of the house-swallow is open: and the swift, rather larger than the house-swallow, with all the toes standing forward; in which it differs from the rest of its kind. All these resemble each other so strongly; that it is not without difficulty the smaller kinds are known asunder.

These are all well known by their very large mouths, which, when they fly, are always kept open; they are not less remarkable for their short slender feet, which scarcely are able to support the weight of their bodies; their wings are of immoderate extent for their bulk; their plumage is glossed with a rich purple; and their note is a slight twittering, which they seldom exert but upon the wing. —This peculiar conformation seems attended with a similar peculiarity of manners. Their food is insects, which they always pursue flying. For this reason, during fine weather, when the insects are most likely to be abroad, the swallows are for ever upon the wing, and seem pursuing their prey with amazing swiftness and agility. All smaller animals, in some measure, find safety by winding and turning, when they endeavour to avoid the greater, the lark thus evades the pursuit of the hawk, and man the crocodile. In this manner, insects upon the wing endeavour to avoid *the swallow;* but this bird is admirably



fitted by nature to pursue them through their shortest turnings. Besides a great length of wing, it is also provided with a long tail, which like a rudder, turns it in its most rapid motions; and thus, while it is possessed of the greatest swiftness, it is also possessed of the most extreme agility.

Early, therefore, in the spring when the returning sun begins to rouse the insect tribe from their annual state of torpidity; when the gnat and the beetle put off their earthly robes, and venture into air; the swallow then is seen returning from its long migration beyond the ocean, and making its way feebly to the shore. At first, with the timidity of a stranger, it appears but seldom, and flies but slowly and heavily along. As the weather grows warmer, and its insect supply increases, it then gathers greater strength and activity. But it sometimes happens that a rainy season, by repelling the insects, stints the swallow in its food; the poor bird is then seen slowly skimming along the surface of the ground, and often resting after a flight of a few minutes. In general, however, it keeps on the wing, and moving with a rapidity that nothing can escape. When the weather promises to be fair, the insect tribe feel the genial influence, and make bolder flights; at which time the swallow follows them in their aerial journeys, and often rises to imperceptible heights in the pursuit. When the weather is likely to be foul, the insects feel the first notices of it; and from the swallow's following low we are often apprized of the approaching change.

When summer is fairly begun, and more than a sufficient supply for sustaining the wants of nature every where offers, the swallow then begins to think of forming a progeny. The nest is built with great industry and art, particularly by the common swallow, which builds it on the tops of chimneys. The martin sticks it to the eaves of houses. The goatsucker, as we are told, builds it on the bare ground. This nest is built with mud from some neighbouring brook, well tempered with the bill, moistened with water, for the better adhesion; and still farther kept firm, by long grass and fibres; within it is lined with goose-feathers, which are ever the warmest and the neatest. The martin covers its nest at top, and has a door to enter at; the swallow leaves hers quite open.[1] But our

[1] The chimney-swallow differs from the window-swallow, according to Montbeillard, in not occupying the same nest more than one season, building annually a new nest, and, if the spot admits, it, fixing it above that occupied the preceding year. "I have found them," says he, "in the shaft of a chimney, thus ranged in tiers, and have counted four, one above another, and all of equal size, plastered with mud mixed with straw and hair. There were some of two different sizes and shapes,—the largest resembled a shallow half-cylinder, open above, a foot in height, and attached to the sides of

European nests are nothing to be compared with those the swallow builds on the coasts of China and Coromandel; the description of which I will give in the plain honest phrase of Willoughby. "On the sea-coast of the kingdom of China," says he, "a sort of party-coloured birds, of the shape of swallows, at a certain season of the year, which is their breeding time, come out of the midland country to the rocks, and from the foam or froth of the sea-water, dashing against the bottom of the rocks, gather a certain clammy glutinous matter, perchance the spawn of whales and other young fishes, of which they build their nests, wherein they lay their eggs and hatch their young. These nests the Chinese pluck from the rocks, and bring them in great numbers into the East Indies to sell. They are esteemed, by gluttons, as great delicacies; who, dissolving them in chicken or mutton broth, are very fond of them; far before oysters, mushrooms, or other dainty and liquorish morsels."[1] What a pity this luxury hath not been introduced among us, and then our great feasters might be enabled to eat a little more!

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the chimney; the smallest were stuck in the corners of the chimney, forming only a fourth of a cylinder, or almost an inverted cone. The first nest, which was the lowest, had the same texture at the bottom as at the sides; but the two upper tiers were separated from the lower by their lining only, which consisted of straw, dry herbs, and feathers. Of the small nests, built in the corners, I could find only two in tiers, and I inferred that they were the property of young pairs, as they were not so compactly built as the larger ones. In habits, instincts, appearance, and migration, *the Swift* resembles the swallow. The common swift is seldom seen in the northern parts of England before the end of May, or the beginning of June; in the south it arrives a week or two earlier. It leaves us again for warmer climates in August, a month or six weeks previous to the departure of the swallows. In this country it haunts cathedrals, towers, churches, and other buildings not constantly inhabited, in the holes, and under the eaves of which it finds a safe retreat, and proper situation to build in.—The nest is formed of straw and other suitable materials, which it collects with great dexterity in its flight. It never alights on the ground, as it is unable to rise from a flat surface.

The *Goatsuckers* are so named from an absurd notion, that they suck the mammæ of goats, a notion which may perhaps have originated in the enormous depth and aperture of the gape. This vulgarism is by no means modern, for it appears, by the Greek appellative, to have existed in the time of Aristotle, though it seems probable, that the first application of the name might have had rather a figurative than a literal meaning. Many of the insectivorous birds, it is true, are found frequently near the persons of cattle and sheep while grazing—for the purpose, doubtless, of preying on the numerous insects which feed on the excretions from these animals: but this habit is common to many genera of birds, and gives no reasonable support to the notion in question, which is incompatible with the organization of the whole class. These birds are inhabitants of Europe, and, indeed, are found in almost all parts of the world; but they are rare here, and more so in appearance than reality, from their crepusculous habits. It is in the new world, especially South America, that they most abound, and are divisible into many species. Asia, and New Holland, moreover, are not without them. Unfitted, like the owls, for full day-light, the goatsuckers hide themselves in some obscure retreat. Twilight is their short period of activity, but the rapidity of their flight, and the size of the mouth, enable them to make the most of this limited time in procuring food. They devote no time to nidification, but deposit their eggs in simple concavities on the ground, and thus the time necessary for the two great objects of animal existence, self-support and propagation, are proportioned to the comparative short periods of their activity. In the day, they sometimes utter a plaintive cry, repeated rapidly three or four times, and indicative of the then negative character of their desires, for they seem to want nothing but retirement and repose.

The *European Goatsucker* is the only species known here. This bird has received a variety of popular names, which have been, many of them, adopted by naturalists; such as flying-toad, square-tailed swallow, night-raven, night-hawk, dor-hawk, churn and fern owl, &c. Its food, mode of taking it, and style of flying caused it to receive the name of square-tailed swallow.

[1] The substance of these nests, according to some, is a sort of froth of the sea, or of the spawn of fish, which is strongly aromatic, though others assert that it has no taste at all; some pretend that it is a kind of gum, collected by the bird on the tree called *Calambone*; others, a viscous humour, which they discharge through the bill at the season of reproduction. The commercial history of these singular nests is much better understood than their composition. "The best nests," says Mr Crawford, "are those obtained in deep, damp caves, and such as are taken before the birds have laid their eggs. The coarsest are those obtained after the young have been fledged. The finest nests are the whitest; that is, those taken before the nest has been rendered impure by the food and fæces of the young birds. The best are white, and the inferior dark-coloured, streaked with blood, or intermixed with feathers. It may be remarked, however, that some of the natives describe the purer nests as the dwelling of the cock-bird, and always so designate them in commerce. Birds' nests are collected twice a-year; and, if regularly collected, and no unusual injury be offered to the caverns, will produce very equally, the quantity being very little, if at all, improved by the caves being left altogether unmolested for a year or two. Some of the caverns are extremely difficult of access, and the nests can only be collected by persons accustomed from their youth to the office. The most remarkable and productive caves in Java, of which I superintended a moiety of the collection for several years, are those of Karang-bolang, in the province of Baglen, on the south coast of the island. There the caves are only to be approached by a perpendicular descent of many hundred feet, by ladders of bamboo and ratan, over a sea rolling violently against the rocks. When the mouth of the cavern is attained, the perilous office of taking the nests must often be performed with torch-light, by penetrating into recesses of the rock, when the slightest trip would be instantly fatal to the adventurers, who see nothing below them but the turbulent surf making its way into the chasms of the rock. The only preparation which the birds' nests undergo is that of simple drying, without direct exposure to the sun, after which they are packed in small boxes, usually of a picul, (about 135 pounds.) They are assorted for the Chinese market into three kinds, according to their qualities, distinguished into first or best, second, and third qualities. Caverns that are regularly managed will afford, in 100 parts, 53 3-10th parts of

The swallow usually lays from five to six eggs, of a white colour, speckled with red; and sometimes breeds twice a year. When the young brood are excluded, the swallow supplies them very plentifully, the first brood particularly, when she finds herself capable of producing two broods in a year. This happens when the parents come early, when the season is peculiarly mild, and when they begin to pair soon. Sometimes they find a difficulty in rearing even a single nest, particularly when the weather has been severe, or their nests have been robbed in the beginning of the season. By these accidents, this important task is sometimes deferred to the middle of September.

At the latter end of September they leave us; and for a few days previous to their departure assemble in vast flocks, on house-tops, as if deliberating on the fatiguing journey that lay before them. This is no slight undertaking, as their flight is directed to Congo, Senegal, and along the whole Morocco shore. There are some, however, left behind in this general expedition, that do not depart till eight or ten days after the rest. These are chiefly the latter weakly broods, which are not yet in a condition to set out. They are sometimes even too feeble to venture till the setting in of winter; while their parents vainly exhort them to efforts which instinct assures them they are incapable of performing. Thus it often happens that the wretched little families, being compelled to stay, perish the first cold weather that comes; while the tender parents share the fate of their offspring, and die with the new-fledged brood.

Those that migrate are first observed to arrive in Africa, as Adanson assures us, about the beginning of October. They are thought to have performed their fatiguing journey in the space of seven days. They are sometimes seen, when interrupted by contrary winds, wavering in their course far off at sea, and lighting upon whatever ship they find in their passage. They then seem spent with famine and fatigue; yet still they boldly venture, when refreshed by a few hours' rest, to renew their flight, and continue the course which they had been steering before.

These are facts proved by incontestable authority; yet it is a doubt whether all swallows migrate in this manner, or whether there may not be some species of this animal that, though externally alike, are so internally different as to be very differently affected by the approach of winter. We are assured from many, and these not contemptible witnesses, that swal-

those of the first quality, 35 parts of those of the second, 11 7-10th parts of those of the third. The common prices for birds' nests at Canton are, for the first sort, 3,500 Spanish dollars the picul, or £5. 18s. 1½d. per pound; for the second, 2,800 Spanish dollars per picul; and, for the third, no more than 1,600 Spanish dollars. In the Chinese markets a still nicer classification of the edible nests is often made than in the island. The whole are frequently divided into three great classes, under the commercial appellation of Paskat, Chikat, and Tung-tung, each of which, according to quality, is subdivided into three inferior orders, and we have, consequently, prices varying from 1,200 Spanish dollars per picul to 4,200. These last, therefore, are more valuable than their weight of silver. Of the quantity of birds' nests exported from the Indian islands, although we cannot state the exact amount, we have data for hazarding some probable conjectures respecting it. From Java there are exported about 200 piculs, or 27,000 lbs., the greater part of which is of the first quality. The greatest quantity is from the Suluk archipelagos, and consists of 530 piculs. From Macassar there are sent about 30 piculs of the fine kind. These data will enable us to offer some conjectures respecting the whole quantity; for the edible swallows' nests being universally and almost equally diffused from Junk, Ceylon, to New Guinea, and the whole produce going to one market, and only by one conveyance, the junks, it is probable that the average quantity taken by each vessel is not less than the sum taken from the ports just mentioned. Taking the quantity sent from Batavia as the estimate, we know that this is conveyed by 5,300 tons of shipping, and, therefore, the whole quantity will be 1,818 piculs, or 242,400 lbs., as the whole quantity of Chinese shipping is 30,000 tons. In the archipelago, at the prices already quoted, this property is worth 1,263,519 Spanish dollars, or £284,290. The value of this immense property to the country which produces it, rests upon the capricious wants of a single people. From its nature, it necessarily follows that it is claimed as the exclusive property of the sovereign, and everywhere forms a valuable branch of his income, or of the revenue of the state. This value, however, is, of course, not equal; and depends upon the situation and the circumstances connected with the caverns in which the nests are found. Being often in remote and sequestered situations, in a country so lawless, a property so valuable and exposed is subject to the perpetual depredations of freebooters; and it not unfrequently happens that an attack upon them is the principal object of the warfare committed by one petty state against another. In such situations, the expense of affording them protection is so heavy, that they are necessarily of little value. In situations where the caverns are difficult of access to strangers, and where there reigns enough of order and tranquillity to secure them from internal depredation, and to admit of the nests being obtained without other expense than the simple labour of collecting them, the value of the property is very great. The caverns of Karang-bolang, in Java, are of this description. These annually afford 6,810 lbs. of nests, which are worth, at the Batavia prices of 3,200, 2,500, and 1,200 Spanish dollars the picul, for the respective kinds, nearly 139,000 Spanish dollars; and the whole expense of collecting, curing, and packing, amounts to no more than 11 per cent. on this account. The price of birds' nests is of course a monopoly price, the quantity produced being by nature limited and incapable of being augmented. The value of the labour expended in bringing birds' nests to market is but a trifling portion of their price, which consists of the highest price which the luxurious Chinese will afford to pay for them, and which is a tax paid by that nation to the inhabitants of the Indian islands. There is, perhaps, no production upon which human industry is exerted, of which the cost of production bears so small a proportion to the market price."—*Crawford's Indian Archipelago.*

lows hide themselves in holes under ground, joined close together, bill against bill, and feet against feet. Some inform us, that they have seen them taken out of the water, and even from under the ice, in bunches, where they are asserted to pass the winter, without motion. Reaumur, who particularly interested himself in this inquiry, received several accounts of bundles of swallows being thus found in quarries, and under the water.[1] These men, therefore, have a right to some degree of assent, and are not to lose all credit from our ignorance of what they aver.

All, however, that we have hitherto dis-

[1] In the 51st vol. of the "Philosophical Transactions" (for 1760), there is a letter addressed by Mr Collinson in answer to the German naturalist Klein, who had advocated the opinion that swallows and other birds do not migrate, but remain torpid during the winter. Subsequent naturalists have added little to the arguments and facts which this letter brings against the opinion; though they have since been supported by collateral and negative testimony.

The opinion that swallows at the time of their disappearance retire under the water and remain there, says this writer, is contrary to nature and reason; for as they cannot live in that state without some degree of breathing, this requires the circulation of the blood however weak and languid. Now as to respiration, is it possible that it should be carried on for so many months under the water without the risk of suffocation? If it were really the case, there must be some particular contrivance in the structure of the organs of the heart to enable it to undergo so remarkable a change of element; but Klein had not even attempted to show that such a peculiar organization existed. This remark of Collinson probably led John Hunter to interest himself on the subject. He states "that he had dissected several swallows, but found nothing in them different from other birds as to the organs of respiration;" and he consequently concludes "that they could not remain for any time under water without being drowned. Collinson then asks why the opinion is never tested by taking a swallow at a time when the species usually disappear, and observing the result of confining it under water in a tub for a week or two. Still proceeding with his negative evidence, he states that towards the end of September the swallows assemble among the reeds in the islands of the Thames, and have done so for ages past; yet he had never heard or read of any fishermen or other person who had ever found a swallow under water in a torpid state; and if so strange a thing had ever happened, it would doubtless have been communicated to the public. Besides, the reeds and willows on those islands are annually cut down for several uses, and yet no swallow has been discovered in his aquatic abode; and considering the multitudes which might be seen on these reeds and willows in the autumn, is it credible that some should not have been found in so frequented a river, during the course of so many years, if the swallows really took up their residence under the water. He adds that in great towns remote from water, where rivers and reeds are not near, he had frequently observed, a little before the swallows disappeared, that they assembled every morning early on the roofs of large houses exposed to the morning sun: this was doubtless in order to collect their numbers before taking their flight.

In the way of positive testimony for the migration of swallows, he says he had often heard Sir Charles Wager, first lord of the Admiralty, relate, that in one of his voyages home, in the spring of the year, as he came into sounding in the channel, a great flock of swallows came and settled on all his rigging; every rope was covered; they hung on one another like a swarm of bees; the deck was filled with them: they seemed almost spent and famished, and were only feathers and bones; but being recruited with a night's rest, they took their flight in the morning. Collinson adds that a similar circumstance had been related to him by the captain of a merchant vessel, on whose statements he could entirely depend. Pennant remarks, on this incident, that the extreme fatigue of the swallows proves that the journey must have been very great, considering the amazing swiftness of these birds. In all probability they had crossed the Atlantic, and were returning from the shores of Senegal or other parts of Africa; so that this account, from that most able and honest seaman, confirms the following later information of M. Adanson, as adduced by Collinson himself, who considers the testimony the more valuable, as coming from a professed naturalist, who went to Africa for the express purpose of collecting information. Adanson says,—"On the sixth of the same month (October), at half-past six in the evening, being about fifty leagues from the coast (between the island of Goree and Senegal) four swallows came to take up their night's lodging on the ship, and alighted on the shrouds. This lucky accident confirmed me in the opinion I had formed, that these birds pass the seas to get into the countries of the torrid zone at the approach of winter in Europe; and accordingly I have since remarked that they do not appear in Senegal but in that season. A circumstance no less worthy of note is that the swallows do not build nests as in Europe, but lie every night by pairs, or single, in the sand upon the seashore, where they rather choose to fix their habitation than up in the country." To this quotation from Adanson, we may add another, relating to an observation which he made on the subject at Senegal, in the month of February:—"The hut where I lodged was large and commodious, but as dark as a subterraneous cavern, even at noon day, because it had no other opening than a door pierced at each end. Here I may observe that a great number of our European swallows resort hither every evening, and pass the night upon the rafters; for, as I have elsewhere mentioned, they do not build their nests in this country, but only come to spend the winter."

Collinson also informs us that he was anxious to test the position of Klein that the sand-martins retire at the approach of winter into the holes in which they had resided during the summer, and there remain in a dormant state. But the sandy precipices in which these birds build are generally so inaccessible, that some years had passed before he could find a situation in which the experiment might be made without difficulty or danger. At last such a situation was found at Byfleet, in Surrey, and the clergyman of the parish, being his friend, and well qualified to assist in the experiment, undertook it at his request. This clergyman in his communication states, that he took a square of about twelve feet, over that part of the cliff where the holes were the thickest, which, in going down from the surface, would, as he judged, take in about forty holes. He set to work, and came to the holes, but found no martins—nothing but old nests at the inner extremity of the holes, which was from a foot and a half to two feet from the entrance. Forty holes were carefully searched without finding any birds; but thirty of them had nests, which were composed of straws and grasses rudely put together, and were sunk almost an inch and a half below the level of the passage.

That the migrations of swallows and other birds should ever have been doubted, can only be accounted for by the fact that these migrations generally take place by night, and in the higher regions of the atmosphere. An

sected, are formed within like other birds; and seem to offer no observable variety. Indeed, that they do not hide themselves under water, has been pretty well proved by the noted experiment of Frisch, who tied several threads, dyed in water-colours, round the legs of a great number of swallows that were preparing for their departure; these, upon their return the ensuing summer, brought their threads back with them, no way damaged in their colour; which they most certainly would, if, during the winter, they had been steeped in water: yet still this is a subject on which we must suspend our assent, as Klein, the naturalist, has brought such a number of proofs in defence of his opinion, that swallows are torpid in winter, as even the most credulous must allow to have some degree of probability.

CHAP. VI.

THE HUMMING-BIRD, AND ITS VARIETIES.[1]

Having given some history of the manners of the most remarkable birds of which accounts can be obtained, I might now go to a very extensive tribe, remarkable for the splendour and the variety of their plumage: but the description of the colours of a beautiful

observant naturalist, however, may sometimes hear them when he cannot see them. Their departures may also occasionally be witnessed, and their preparations for departure still more frequently. In a note to his "Sacred History of the World,' Mr Sharon Turner, some other of whose quotations in illustration of the general subject we have adopted, quotes the following from the "Berks Chronicle," descriptive of the migratory movement which took place in October, 1829:—

"We have had sharp frosts during the week, and large flights of plovers and teams of wild ducks and geese have passed hence in a northern direction. On Wednesday morning last the roofs of all the higher ranges of houses in Prospect Street in this town (Reading) were covered with thousands of the swallow tribe, which had there assembled preparatory to their annual migration to a warmer climate. From this chirping and fluttering about, they seemed to be in grand debate; and about nine o'clock the larger division departed in a south-west direction, and was afterwards followed by the others. The morning was remarkably fine and cheering, and the little emigrants were pluming their wings soon after sunrise, preparing, as it were, for their long voyage and still dubious destination."

[1] *Birds of South America.*—Though least in size, the glittering mantle of the humming-bird entitles it to the first place in the list of the new world. It may truly be called the bird of Paradise; and had it existed in the old world, would have claimed the title, instead of the bird which has now the honour to bear it. See it darting through the air, almost as quick as thought!—now it is within a yard of your fire!—in an instant it is gone!—now it flutters from flower to flower to sip the silver dew—it is now a ruby—now a topaz—now an emerald—now all burnished gold. Cayenne and Demerara produce the same humming-birds. Perhaps you would wish to know something of their haunts. Chiefly in the months of July and August the tree called Bois Immortel, very common in Demerara, bears abundance of red blossoms, which stays on the trees some weeks: then it is that most of the humming-birds are very plentiful. The wild red sage is also their favourite shrub, and they buzz like bees round the blossom of the Wallaba tree. Indeed, there is scarce a flower in the interior or on the sea-coast, but what receives frequent visits from one or other of the species. On entering the forest on the rising land in the interior, the blue and green, the smallest brown, no bigger than the humble bee, with two long feathers in the tail, are to be seen. As you advance towards the mountains of Demerara, other species of humming-birds present themselves. It seems to be an erroneous opinion that the humming-bird lives entirely on the honey-dew. Almost every flower of the tropical climates contains insects of one kind or other; now the humming-bird is most busy about the flowers an hour or two before sunrise, and after a shower of rain; and it is just at this time that the insects come out to the edge of the flower, in order that the sun's rays may dry the nocturnal dew and rain which they have received. On opening the stomach of the humming-bird, dead insects are found there.

Next to the humming-birds, the cotingas display the gayest plumage. They are of five species. Perhaps the scarlet cotinga is the richest of the five, and is one of those birds which are found in the deepest recesses of the forest. His crown is flaming red; to this abruptly succeeds a dark shining brown, reaching half way down the back; the remainder of the back, the rump, and tail, the extremity of which is edged with black, are a lovely red; the belly is somewhat lighter red; the breast reddish black; the wings brown. He has no song, is solitary, and utters a monotonous whistle which sounds like "quet." He is fond of the seeds of the hitia tree, and those of the siloaboli trees. The purple-throated cotinga has black wings, and every other part a light and glossy blue, save the throat, which is purple. The pompadour cotinga is entirely purple, except his wings, which are white, their first five feathers tipped with brown. The fifth species is the celebrated campanero of the Spaniards, called dara by the Indians, and bell-bird by the English. He is about the size of the jay. His plumage is white as snow. On his forehead rises a spiral tube nearly three inches long. It is jet black, dotted all over with small white feathers. It has a communication with the palate, and, when filled with air, looks like a spire; when empty, it becomes pendulous. His note is loud and clear, like the sound of a bell, and may be heard at the distance of three miles. In the midst of these extensive wilds, generally on the dried top of an aged mora, almost out of gun reach, you will see the campaneros. No sound or song from any of the winged inhabitants of the forest, not even the clearly pronounced "whip-poor-wills" from the goat-sucker, cause such astonishment as the toll of the campanero. With many of the feathered race, he pays the tribute of a morning and evening song, and even when the meridian sun has shut in silence the mouth of almost the whole of animated nature, the campanero still cheers the forest. You hear his toll, and then a pause again, and then a toll again, and again a pause. Then he is silent for six or eight minutes, and then another toll, and so on. He is never seen to feed with the other cotingas, nor is it known in what part of Guiana he makes his nest.

Whilst the cotingas attract your attention by their superior plumage, the singular form of the toucan makes a lasting impression on your memory. There are three species of toucans in Demerara, and three diminutives,

bird, has nothing in it that can inform or entertain; it rather excites a longing, which it is impossible for words to satisfy. Naturalists, indeed, have endeavoured to satisfy this desire by coloured prints; but, beside that these at best give only a faint resemblance of nature, and are a very indifferent kind of painting, the bird itself has a thousand beau-

which may be called toucanets. The largest of the first species frequents the mangrove trees on the sea-coast. He is never seen in the interior till you reach Macoushia, where he is found in the neighbourhood of the river Tacatore. The other two species are very common. They feed entirely on the fruits of the forest, and, though of the pie kind, never kill the young of other birds, or touch carrion. They are very noisy in rainy weather. The sound which the bouradi or the larger makes, is like the clear yelping of a puppy dog, and you fancy he says "pia-po-o-co," and thus the South American Spaniards call him piapoco. All the toucanets feed on the same trees on which the toucan feeds, and every species of this family, of enormous bill, lays its eggs in the hollow trees. They are social, but not gregarious. You may sometimes see eight or ten in company, and from this you may suppose they are gregarious; but upon closer examination, you will find it has only been a dinner party, which breaks up and disperses towards roosting time. The flight of the toucan is by jerks; in the action of flying it seems incommoded by its huge disproportioned bill; if the extraordinary form and size of the bill expose the toucan to ridicule, its colours make it amends.

The houtou ranks high in beauty amongst the birds of Demerara; his whole body is green, with a bluish cast in the wings and tail; his crane, which he erects at pleasure, consists of black in the centre, surrounded with lovely blue of two different shades; he has a triangular black spot, edged with blue, behind the eye, extending to the ear; and on his breast a sable tuft, consisting of nine feathers edged also with blue. This bird seems to suppose that its beauty can be increased by trimming the tail, which undergoes the same operation as our hair in a barber's shop, only with this difference, that it uses its own beak, which is serrated, in lieu of a pair of scissors; as soon as his tail is full grown, he begins about an inch from the extremity of the two largest feathers in it, and cuts away the web on both sides of the shaft, making a gap about an inch long. Both male and female Adonise their tails in this manner, which gives them a remarkable appearance amongst other birds. The thick and gloomy forests are the places preferred by the houtou. In those far-extending wilds, about day-break, you hear him articulate, in a distinct and mournful tone, "houtou, houtou." Move cautiously on where the sound proceeds from, and you will see him sitting in the underwood, and very rarely is he seen in the lofty trees, except the bastard siloaboli tree, the fruit of which is grateful to him. He makes no nest, but rears his young in a hole in the sand, generally on the side of a hill.

The cassique, in size, is larger than the starling; he covets the society of man, but disdains to live by his labours. When nature calls for support, he repairs to the neighbouring forest, and there partakes of the store of fruits and seeds which she has produced for her aerial tribes. When his repast is over, he returns to man, and pays the little tribute which he owes him for his protection; he takes his station on a tree close to his house, and there for hours together pours forth a succession of imitative notes. His own song is sweet, but very short. If a toucan be yelping in the neighbourhood, he drops it, and imitates him. Then he will amuse his protector with the cries of different species of the woodpecker; and when the sheep bleat, he will distinctly imitate them. Then comes his own song again, and if a puppy dog or a guinea-fowl interrupt him, he takes them off admirably; and by his different gestures during the time, you would conclude that he enjoys the sport.

The cassique is gregarious, and imitates any sound he hears with such exactness, that he goes by no other name than that of mocking-bird amongst the colonists. At breeding time, a number of these pretty choristers resort to a tree near the planter's house, and from its outside branches weave their pendulous nests. So conscious do they seem that they never give offence, and so little suspicious are they of receiving any injury from man, that they will choose a tree within forty yards from his house, and occupy the branches so low down that he may peep into the nests. The proportions of the cassique are so fine, that he may be said to be a model of symmetry in ornithology. On each wing he has a bright yellow spot, and his rump, belly, and half the tail, are of the same colour. All the rest of the body is black. His beak is the colour of sulphur, but it fades in death, and requires the same operation as the bill of the toucan to make it keep its colours.

You would not be long in the forests of Demerara without noticing the woodpeckers. You may meet with them feeding at all hours of the day. Well may they do so. Were they to follow the example of most of the other birds, and only feed in the morning and evening, they would be often on short allowance, for they sometimes have to labour three or four hours at the tree before they get at the food. The sound which the largest kind makes in hammering against the bark of the tree, is so loud, that you would never suppose it to proceed from the efforts of a bird. You would take it to be the woodman, with his axe, trying, by a sturdy blow often repeated, whether the tree was sound or not. There are fourteen species here; the largest the size of a magpie, the smallest not bigger than the wren. They are all beautiful, and the greater part of them have their heads ornamented with a fine crest, movable at pleasure. It is said if you once give a dog a bad name, whether innocent or guilty, he never loses it. It sticks close to him wherever he goes. He has many a kick and many a blow to bear on account of it, and there is nobody to stand up for him. The woodpecker is little better off. The proprietors of woods in Europe have long accused him of injuring their timber, by boring holes in it, and letting in the water, which soon rots it. The colonists in America have the same complaints against him. Had he the power of speech, he could soon make a defence. "Mighty lords of the woods," he would say to man, "why do you wrongfully accuse me? Why do you hunt me up and down to death for an imaginary offence? I have never spoiled a leaf of your property, much less your wood. Your merciless shot strikes me at the very time I am doing you a service. But your shortsightedness will not let you see it, or your pride is above examining closely the actions of so insignificant a little bird as I am. If there be that spark of feeling in your breast, which they say man possesses, or ought to possess, above all other animals, do a poor injured creature a little kindness, and watch me in your woods only for one day. I never wormed your healthy trees. I should perish for want in the attempt. The sound bark would easily resist the force of my bill; and were I even to pierce through it, there would be nothing inside that I could fancy, or my stomach digest. I often visit them, it is true, but a knock or two convinces me that I must go elsewhere for support; and were you to listen attentively to the sound which my bill causes, you would know whether I am upon a healthy or an unhealthy tree. Wood and bark are not my food. I live entirely upon the insects which have already formed a lodgement in the distempered tree. When the sound informs me that

ties that the most exquisite artist is incapable of imitating. They, for instance, who imagine they have a complete idea of the beauty of the little tribe of manikin birds, from the pictures we have of them, will find themselves deceived, when they compare their draughts with nature. The shining greens, the changeable purples, and the glossy reds, are beyond the reach of the pencil; and very far beyond the coloured print, which is but a poor substitute to painting. I have therefore declined entering into a minute description of foreign birds of the sparrow kind; as sounds would never convey an adequate idea of colours.

There is one species, however, that I will conclude the history of this class with; as, though the least, it will certainly be allowed the most beautiful of all others. In quadrupeds, the smallest animals are noxious, ugly, and lothesome; the smallest of birds are the most beautiful, innocent, and sportive. Of all those that flutter in the garden, or paint the landscape, the humming-bird is the most delightful to look upon, and the most inoffensive.

Of this charming little animal there are six or seven varieties,[1] from the size of a small wren down to that of an humble-bee. A European could never have supposed a bird existing so very small, and yet completely furnished out with a bill, feathers, wings,

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my prey is there, I labour for hours together till I get at it; and, by consuming it, for my own support, I prevent its further depredations in that part. Thus I discover for you a hidden and unsuspected foe, which has been devouring your wood in such secrecy, that you had not the least suspicion it was there. The hole which I make, in order to get at the pernicious vermin, will be seen by you as you pass under the tree. I leave it as a signal to tell you, that your tree has already stood too long. It is past its prime. Millions of insects, engendered by disease, are preying upon its vitals: ere long it will fall a log in useless ruins. Warned by this loss, cut down the rest in time, and spare, O spare, the unoffending woodpecker."—*Wanderings of Charles Waterton in South America.*

[1] The family of humming-birds (*Trochilidæ*) is divided into numerous genera. Upwards of 100 species are now known to naturalists. Recent discoveries have proved that their range of habitation is more extended than was once imagined; for though they chiefly abound in the intertropical latitudes of America, many visit the temperate and colder portions of that continent. The ruby-throated humming-bird (*Trochilus Colubris*), passes north as far as the interior of Canada, migrating like the swallow. Nor is this the only species which extends into a colder climate. Captain King, while on his survey of the southern coasts, met with numerous species flying about in a snow-storm near the Straits of Magellen, and discovered two species (*Trochilus Fernandensis*, and *T. Stokesii*) in the island of Juan Fernandez. Still, however, the central regions of the continent, and the islands adjacent, are their chief resort. There they people the woods and the gardens, glancing in the sun like meteors as they flit by with inconceivable rapidity, or, suspended on their burnished and quivering wings, explore the nectary of some scented blossom. These birds may be almost said to live upon the wing. There is no bird that equals them in power of flight, and they are quick as lightning in their motions. Their wings are of extraordinary length, and this, with their shape and the character of the feathers composing them, contributes to their efficiency. The feet and legs, on the contrary, are small and feeble; they are, in fact, of merely second-rate importance in the economy of the humming-bird. The ground and the trees are not its element. It sometimes, indeed, settles on a twig, while it preens its plumage of glittering scale-like feathers, or arranges the moss and down of its nest; but the air is its abiding place, where it feeds and passes the whole of its active existence. Wilson observes that "the humming-bird is extremely fond of tubular flowers, and I have often stopped with pleasure to observe his manœuvres among the blossoms of the trumpet flower. When arrived before a thicket of those that are full blown, he poises or suspends himself on the wing, for the space of two or three seconds, so steadily, that his wings became invisible, or only like a mist, and you can plainly distinguish the pupil of his eye looking round with great quickness and circumspection." With respect, then, to the shape of these powerful organs of flight, we may notice that they are narrow-pointed, and more or less curved inwards, a good deal resembling those of the swift,—and are mainly composed of the primary quill feathers, beautifully graduated, the first or outer one being the longest. The secondary quill feathers are very short, and occupy the inner edge at the base of the primaries, taking up little room, and adding nothing to the breadth of the wing as in birds in general. The structure of these feathers must not be overlooked; they consist of a strong and peculiarly elastic shaft, which in many species is very thick at its commencement. On each side of this shaft is a vane, composed of narrow, closely set, springy plumets, so compacted together, as to give the idea of a thin metallic or horny web, and which, cutting the air at every stroke, produces that humming noise which is heard while the bird hovers over the flower, or darts arrow-like along. Of the immense strength of the pectoral muscles by whose actions these long pointed wings are thus rapidly agitated, we can scarcely form an adequate conception.

Next to the wings, the tail is the most important agent as an organ of aerial progression. It is not only the rudder by which a bird directs its course, or turns and wheels, but it adds to the superficies of the body without increasing its weight. In this group the tail is ample, but varies extremely in shape; in some species it is square, in others forked, in some pointed, but in all it is composed of feathers closely resembling those of the wing in texture. Thus is the humming-bird constituted for flight; nor is this extremely rapid merely, but it is capable of long continuance. The flitting progress of the humming-bird from flower to flower resembles that of a bee,—but is infinitely more quick. When, however, the bird is journeying, it sweeps through the air in long undulations, rising and sinking alternately.

It has been supposed by many that the nectar of flowers constitutes the sole food of this charming race, but such is not the fact. Nectar is no doubt a part of their diet, but by no means the whole: they feed on the small insects which lurk in the nectary, or wander over the petals,—nay, they even take insects on the wing, as was observed by Wilson, who also found their fragments in the stomach of such as he examined; and Audubon states, in confirmation, that insects, especially those of the coleopterous order, are the principal food of the humming-bird. The bill, fitted for penetrating into the recesses of flowers, is long and slender, but varies in shape. According to Brisson and others, the tongue consists of two muscular tubes. This organ, which in

and intestines, exactly resembling those of the largest kind. A bird not so big as the end of one's little finger would probably be supposed but a creature of imagination, were it not seen in infinite numbers, and as frequent as butterflies in a summer's day, sporting in the fields of America, from flower to flower, and extracting their sweets with its little bill.

The smallest humming-bird is about the

the humming-bird is mainly instrumental in procuring food, is capable of being protruded to a considerable distance, as we see in the wryneck, woodpecker, &c. Audubon says, that the double-tubed tongue of the humming-bird is covered with a glutinous saliva, so that the insect adheres to it when touched; hence the bird has only to dart its tongue at its prey, and retract it into its mouth.

Diminutive as they are, these beautiful creatures are bold and intrepid, and defend their nests against intruders with the greatest spirit. Their powers of flight give them every advantage in these aerial combats over birds much larger than themselves, at whose eyes they tilt with their sharp-pointed beak, uttering, at the same time, a shrill piercing shriek. Two males seldom meet without a battle: and while the female is sitting her mate attacks indiscriminately every bird that approaches, exhibiting the utmost fury. The nest of the humming-bird varies in different species. We have seen some built on the branch of a tree, others attached to the extreme twigs, so as to wave in the breeze. The materials with which they are constructed are for the most part, the cotton or down of various plants, beautifully interwoven; some species add an outside layer of moss or lichen. It appears that the number of eggs laid by the female is usually two, and their colour pure white.

That these beautiful and elegant birds should not be kept in captivity will not surprise those who know the difficulty of preserving them, even in their own regions, for any length of time, in imprisonment. Several attempts have, however, been made; and, on one occasion, two nestlings of a species termed the Mango humming-bird were actually brought alive to England, and lived for a short time in the possession of Lady Hammond; they were very docile, and fed on honey, but we do not know whether insects were offered them or not. Audubon states that he has seen many humming-birds in partial confinement; and that, when fed with honey or syrup exclusively, they soon died in a state of emaciation, but that, when duly supplied with fresh flowers (abounding with insects), and surrounded with gauze-netting, through which insects could enter, they lived in health and were active. Indeed, he mentions an instance in which several were thus kept for the space of twelve months, when they were restored to liberty, the person who attended to them having a long voyage to perform.

"I remember," says a correspondent of the Magazine of Natural History, "a pair of these beautiful little creatures busily building a nest in the branch of an orange-tree, which was close to the outer side of the open piazza of a house in Spanish Town, Jamaica: in this apartment, situated on the north side of the house, the family breakfasted and lunched. I spent three days there; and, while taking my meals, had at least an equal treat, in seeing these smallest of the feathered tribes gaily and actively employed in their building process. I have now in my possession a nest of the bee humming bird, which I removed from the end of a mango-tree (*Mangiferia indica*), which was not a foot above my head, and close to the door of a dwelling-house. I cannot quit this article without speaking of the delight that was afforded me, in Jamaica, by seeing humming-birds feeding on honey, in the florets of the great aloe (*Agave americana*, L.) On the side of a hill upon Sutton's estate were a considerable number of aloe plants, of which about a dozen were in full blossom. They were spread over a space of about twenty yards square. The spikes bearing bunches of flowers in a thyrsus, were from twelve to fifteen feet high; on each spike were many hundred flowers, of a bright yellow colour, each floret of a tubular shape, and containing a good-sized drop of honey. Such an assemblage of floral splendour was in itself most magnificent and striking; but it may be imagined how much the interest caused by this beautiful exhibition was increased, by vast numbers of humming-birds, of various species, fluttering at the opening of the flowers, and dipping their bills, first into one floret, and then into another—the sun, as usual, shining bright upon their varied and beautiful plumage."

The following cut represents the *Bar-tailed Humming-bird*.



This splendid species seems to have been first noticed by Dr Shaw, in his General Zoology, and figured from a specimen in Bullock's museum. It is most remarkable for the splendid colouring and development of its tail, which Lesson compares to that of the New Holland menura. It is composed of ten broad feathers, gradually exceeding each other by about half an inch, three quarters, &c., and the last by above one inch and a half longer than the others. The colour may be said to be a brilliant reddish orange, with a brazen or metallic lustre of the greatest clearness, according to the various lights in which it is placed assuming a greater tinge of red or yellow. The tip of each feather has a broad black bar, and the lower part of the web of the outer feather is of the same colour. When the tail is closed, the appearance is as if regularly barred with black. The upper parts of the plumage are of a golden green, except the rump, which is of a fine madder tint, but without any metallic lustre. The feathers upon this part are more tufted, and thicker than usual. The whole of the under surface, as far as the upper part of the belly, is of a bright emerald green, brightest on the fore part of the throat. The lower belly is dull brownish green, the vent whitish. Lesson has represented another state of this bird, which he thinks is that of the female. All the upper parts are of a uniform green. The throat and breast, instead of the emerald-coloured scaly gorget, are of a dull yellowish gray, which colour occupies also the

size of a hazel-nut. The feathers on its wings and tail are black; but those on its body, and under its wings, are of a greenish brown, with a fine red cast, or gloss, which no silk or velvet can imitate. It has a small crest on its head, green at the bottom, and, as it were, gilded at the top; and which sparkles in the sun like a little star in the middle of its forehead. The bill is black, straight, slender, and of the length of a small pin. The larger humming-bird is nearly half as big as the common wren, and without a crest on its head; but, to make amends, it is covered, from the throat half way down the belly, with changeable crimson-coloured feathers, that, in different lights, change to a variety of beautiful colours, much like an opal. The heads of both are small, with very little round eyes, as black as jet.

It is inconceivable how much these add to the high finishing and beauty of a rich luxurious western landscape. As soon as the sun is risen, the humming-birds, of different kinds, are seen fluttering about the flowers, without ever lighting upon them. Their wings are in such rapid motion, that it is impossible to discern their colours, except by their glittering. They are never still but continually in motion, visiting flower after flower, and extracting its honey as if with a kiss. For this purpose they are furnished with a forky tongue, that enters the cup of the flowers, and extracts its nectared tribute. Upon this alone they subsist. The rapid motion of their wings brings out a humming sound, from whence they have their name; for whatever divides the air swiftly, must thus produce a murmur.

The nests of these birds are not less curious than the rest; they are suspended in the air, at the point of the twigs of an orange, a pomegranate, or a citron-tree; sometimes even in houses, if they find a small and convenient twig for the purpose. The female is the architect, while the male goes in quest of materials; such as cotton, fine moss, and the

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rest of the under parts. The tail is about only half the length, the feathers of the same broad form; the outer one of a yellowish, the others of a reddish coppery lustre, with a slight indication of a darker shade at the tips, but without any distinct bar.

There seems a little uncertainty regarding the native country of this bird. Shaw's specimens were said to come from Peru; and Lesson mentions the interior of Brazil for those from which he took his drawings and descriptions.

The following represents the *Topaz-throated Humming-bird.*



This species is without any exception one of the most splendid of the whole race; the plumage in every part is composed of the scaly formed feathers, which are always present when a metallic lustre prevails; and in every position, its brilliant colours receive a variation of tint differing from that last seen, and superior in splendour to any thing with which we could compare it. It is a large species also, and in many ways is a most interesting bird. The African form is naturally called to our remembrance by the general appearance of it to the Cyniridæ, in which the shape of the gorget and tail leads still nearer. In its habits it is also curious, being said to frequent the banks of rivers, skimming along their surface after insects, and often perching on dried twigs along their margins: in this there is an approximation to several groups. The length of this bird, not including the long centre tail feathers, is five inches and a half, these exceed the others by nearly three inches; the colours of the whole plumage of the body may be said to be a rich brownish orange, in some lights appearing of the deepest lake, and in others of a brilliant ruby colour, tinted with golden; on the lower surface the golden lustre is most prevalent, above, the deep shade and ruby tint; the gorget is alternately of a topaz-yellow or emerald green, and it is surrounded by a shade of nearly velvet black, which gradually assumes a purple tint, and shades into the colour of the body; the wings are very long and powerful; the tail is above of a golden green shaded with red, below of a bright chestnut; in form it is rather rounded, and the two centre feathers make it appear sometimes very lengthened, sometimes forked, according to their position; the tarsi are feathered to the division of the toes. The young differ in wanting the long feathers in the tail, the two centre plumes of which exceed the others by about one-eighth of an inch; the plumage of the upper parts is of a bright green, with the ruby tints appearing at intervals; the under part has more of the red colour, and is shaded with green and bright orange; the gorget has not appeared, though the space for it is clearly seen. The female is somewhat less than the young males; the centre tail feathers are slightly longer; the prevailing colour of the plumage is brilliant emerald green, with metallic lustre, but which is somewhat diminished by a gray tint which pervades the whole; the gorget is marked by brown feathers, which have a golden lustre when placed in the light, but is not very distinctly defined; the vent is gray: the outer tail feathers are of a dull green, the next pair are of a brilliant violet, the others of a bright chestnut. These beautiful birds are found in Cayenne and Guiana.

For works on humming-birds, the reader is referred to three beautiful volumes by Lesson, containing 219 plates, and to the Naturalist's Library, by Sir William Jardine, vols. I. and II. Edinburgh, 1833. Both Wilson and Audubon have written well on the northern humming-bird.

fibres of vegetables. Of these materials a nest is composed, of about the size of a hen's egg cut in two, admirably contrived, and warmly lined with cotton. They lay two eggs at a time, and never more, about the size of small peas, and as white as snow, with here and there a yellow speck. The male and the female sit upon the nest by turns; but the female takes to herself the greatest share. She seldom quits the nest, except a few minutes in the morning and evening, when the dew is upon the flowers, and their honey in perfection. During this short interval, the male takes her place; for, as the egg is so small, the exposing it ever so short a time to the weather would be apt to injure its contents, the surface exposed being so great in comparison to the bulk. The time of incubation continues twelve days; at the end of which the young ones appear, much about the size of a blue-bottle fly. They are at first bare; by degrees they are covered with down; and at last feathers succeed, but less beautiful at first than those of the old ones.

"Father Labat's companion in the mission to America, found the nest of a humming-bird in a shed that was near the dwelling-house, and took it in at a time when the young ones were about fifteen or twenty days old; he then placed them in a cage at his chamber-window, to be amused by their sportive flutterings; but he was soon surprised to see the old ones, that came and fed their brood regularly every hour in the day. By these means they themselves soon grew so tame that they seldom quitted the chamber; but without any constraint came to live with their young ones. All four have frequently come to perch upon their master's hand, chirruping as if they had been at liberty abroad. He fed them with a very fine clear paste, made of wine, biscuit, and sugar; they thrust their tongues into this paste, till they were satisfied, and then fluttered and chirruped about the room. I never beheld any thing more agreeable," continues he, "than this lovely little family that had taken possession of my companion's chamber, and that flew out and in just as they thought proper; but were ever attentive to the voice of their master, when he called them. In this manner they lived with him for above six months; but at a time when he expected to see a new colony formed, he unfortunately forgot to tie up their cage to the ceiling at night to preserve them from the rats, and he found they were devoured in the morning."

These birds on the continent of America, continue to flutter the year round; as their food, which is the honey of flowers, never forsakes them in those warm latitudes where they are found. But it is otherwise in the islands of the Antilles, where, when the winter season approaches, they retire, and, as some say, continue in a torpid state during the severity of that season. At Surinam and Jamaica, where they constantly have flowers, these beautiful birds are never known to disappear.

It is a doubt whether or not these birds have a continued note of singing. All travellers agree, that, beside the humming noise produced by their wings, they have a little interrupted chirrup; but Labat asserts, that they have a most pleasing melancholy melody in their voices, though small, and proportioned to the organs which produce it. It is very probable that, in different places, their notes are also different; and as there are some that continue torpid all the winter, there may likewise be some with agreeable voices, though the rest may in general be silent.

The Indians formerly made great use of this bird's plumage, in adorning their belts and head-dress. The children take them in the fields upon rings smeared with bird-lime: they approach the place where the birds are flying, and twirling their rings in the air, to allure them, either by the colour or the sound, that the simple little creature comes to rest upon the ring, and is seized. They are then instantly killed and gutted, and hung up in the chimney to dry. Those who take greater care, dry them in a stove, which is not so likely to injure the plumage as the foregoing method. Their beautiful feathers were once the ornament of the highest rank of savage nobility; but at present they take the bird rather for the purpose of selling it as a curiosity to the Europeans, than that of ornament for themselves. All the taste for savage finery is wearing out fast, even among the Americans. They now begin to adopt, if not the dresses of Europe, at least the materials of which they are composed. The wandering warrior is far from thinking himself fine at present with his bow and his feathered crown: his ambition reaches to higher ornaments; a gun, a blue shirt, and a blanket.

A

HISTORY OF BIRDS.

BOOK VI.

OF BIRDS OF THE CRANE KIND.

CHAP. I.

OF BIRDS OF THE CRANE KIND IN GENERAL.

The progressions of Nature from one class of beings to another, are always by slow and almost imperceptible degrees. She has peopled the woods and the fields with a variety of the most beautiful birds; and, to leave no part of her extensive territories untenanted, she has stocked the waters with its feathered inhabitants also: she has taken the same care in providing for the wants of her animals in this element, as she has done with respect to those of the other; she has used as much precaution to render water-fowl fit for swimming, as she did in forming land-fowl for flight; she has defended their feathers with a natural oil, and united their toes by a webbed membrane: by which contrivances they have at once security and motion. But between the classes of land-birds that shun the water, and of water fowl that are made for swimming and living on it, she has formed a very numerous tribe of birds, that seem to partake of a middle nature; that, with divided toes, seemingly fitted to live upon land, are at the same time furnished with appetites that chiefly attach them to the waters. These can properly be called neither land-birds nor water-fowl, as they provide all their sustenance from watery places, and yet are unqualified to seek it in those depths where it is often found in greatest plenty.[1]

This class of birds, of the crane kind, are to be distinguished from others rather by their appetites than their conformation. Yet even in this respect they seem to be sufficiently discriminated by nature: as they are to live among the waters, yet are incapable of swimming in them, most of them have long legs, fitted for wading in shallow waters, or long bills proper for grouping in them.

Every bird of this kind, habituated to marshy places, may be known, if not by the length of its legs, at least by the scaly surface of them. Those who have observed the legs of a snipe or a woodcock, will easily perceive my meaning; and how different the surface of the skin that covers them is from that of the pigeon or the partridge. Most birds of this kind also, are bare of feathers half way up the thigh; at least, in all of them, above the knee. —Their long habits of wading in the waters, and having their legs continually in moisture, prevents the growth of feathers on those parts; so that there is a surprising difference between the legs of a crane, naked of feathers almost up to the body, and the falcon, booted almost to the very toes.

The bill is also very distinguishable in most of this class. It is, in general, longer than that of other birds, and in some finely fluted on every side; while at the point it is possessed of extreme sensibility, and furnished with nerves, for the better feeling their food at the bottom of marshes, where it cannot be seen. Some birds of this class are thus fitted with every convenience; they have long legs, for wading; long necks, for stooping; long bills, for searching; and nervous points, for feeling. Others are not so amply provided for; as some have long bills, but legs of no great length; and others have long necks, but very short legs. It is a rule which universally holds, that where the bird's legs are long, the neck is also long in proportion. It would indeed be an incurable defect in the bird's conformation, to be lifted upon stilts above its food, without being furnished with an instrument to reach it.

If we consider the natural power of this

[1] The term *waders* is now applied to this description of birds.

class, in a comparative view, they will seem rather inferior to those of every other tribe. Their nests are more simple than those of the sparrow; and their methods of obtaining food less ingenious than those of the falcon; the pie exceeds them in cunning; and though they have all the voraciousness of the poultry tribe, they want their fecundity. None of this kind, therefore, have been taken into man's society, or under his protection; they are neither caged, like the nightingale; nor kept tame, like the turkey; but lead a life of precarious liberty, in fens and marshes, at the edges of lakes, and along the sea-shore. They all live upon fish or insects, one or two only excepted; even those that are called *mud-suckers*, such as the snipe and the woodcock, it is more than probable, grope the bottom of marshy places only for such insects as are deposited there by their kind, and live in a vermicular state, in pools and plashes, till they take wing, and become flying insects.

All this class, therefore, that are fed upon insects, their food being easily digestible, are good to be eaten; while those who live entirely upon fish, abounding in oil, acquire in their flesh the rancidity of their diet, and are, in general, unfit for our tables. To savages, indeed, and sailors on a long voyage, every thing that has life seems good to be eaten; and we often find them recommending those animals as dainties, which they themselves would spurn at after a course of good living. Nothing is more common in their journals than such accounts as these—— "This day we shot a fox—pretty good eating: this day we shot a heron—pretty good eating: and this day we killed a turtle"——which they rank with the heron and the fox, as "pretty good eating." Their accounts, therefore, of the flesh of these birds, are not to be depended upon; and when they cry up the heron or the stork of other countries as luxurious food, we must always attend to the state of their appetites who give the character.

In treating of this class of birds, it will be best to observe the simplest method possible; neither to load the memory with numerous distinctions, nor yet confuse the imagination by a total want of arrangement. I will, therefore, describe some of the larger sorts separately; as, in a history of birds, each of these demands peculiar distinction. The crane, the stork, the Balearic crane, the heron, the bittern, with some others, may require a separate history. Some particular tribes may next offer, that may very naturally be classed together; and as for all the smaller and least remarkable sorts, they may be grouped into one general description.

CHAP. II.

THE CRANE.[1]



There is something extraordinary in the different accounts we have of this bird's size and dimensions. Willoughby and Pennant make the crane from five to six feet long, from the tip to the tail. Other accounts say that it is above five feet high; and others, that it is as tall as a man. From the many which I myself had seen, I own this imputed magnitude surprised me; as from memory I was convinced they could neither be so long nor

[1] The above Cut represents the *Common Crane*. For *Numidian Crane*, see Plate XX. fig. 1. and for *Collared Crane*, fig. 6. same Plate. The *Gigantic Crane*, or, as it is called in India, the *Adjutant* (see Plate XX. fig. 12.) is a very large species, which belongs to the stork genus, measuring, from tip to tip of the wings, nearly fifteen feet. The bill is of vast size, nearly triangular, and sixteen inches round at the base. The legs and half the thighs are naked, and the naked parts are full three feet in length. This bird is an inhabitant of Bengal and Calcutta, and is sometimes found on the coast of Guinea. It arrives in the internal parts of Bengal before the period of the rains, and retires as soon as the dry season commences. Its aspect is filthy and disgusting; yet it is one of the most useful birds of these countries, in clearing them of snakes and noxious reptiles and insects. It seems to finish the work began by the jackal and vulture—the clearing away the flesh of animals, and these birds removing the bones, and swallowing them entire. They sometimes feed on fish; and one of them will generally devour as much as would serve four men. On opening the body of a gigantic crane, a land-tortoise, ten inches long, and a large black male cat, were found entire within it; the former in the craw, and the latter in the stomach. Being altogether undaunted at the sight of mankind, they are soon rendered familiar; and when fish or other food are thrown to them, they catch them very nimbly, and immediately swallow them whole. The gigantic cranes are believed by the Indians to be animated by the souls of the Brahmins, and consequently to be invulnerable. Mr Ives, in attempting to kill some of them with his gun, missed his shot several times, which the by-standers observed with the greatest satisfaction, telling him triumphantly that he might shoot at them as long as he pleased, but he never would be able to kill them

so tall. Indeed, a bird, the body of which is not larger than that of a turkey-hen, and acknowledged on all hands not to weigh above ten pounds, cannot easily be supposed to be almost as long as an ostrich. Brisson, however, seems to give this bird its real dimensions, when he describes it as something less than the brown stork, about three feet high, and about four from the tip to the tail. Still, however, the numerous testimonies of its superior size are not to be totally rejected; and, perhaps, that from which Brisson took his dimensions, was one of the smallest of the kind.

The crane, taking its dimensions from him, is exactly three feet four inches from the tip to the tail, and four feet from the head to the toe. It is a tall slender bird, with a long neck and long legs. The top of the head is covered with black bristles, and the back of it is bald and red, which sufficiently distinguishes this bird from the stork, to which it is very nearly allied in size and figure. The plumage in general, is ash-coloured; and there are two large tufts of feathers, that spring from the pinion of each wing. These bear a resemblance to hair, and are finely curled at the ends, which the bird has a power of erecting and depressing at pleasure. Gesner says, that these feathers, in his time, used to be set in gold, and worn as ornaments in caps.

Such are the dimensions of a bird, concerning which, not to mention modern times, there have been more fables propagated than of any other. It is a bird with which all the ancient writers are familiar; and, in describing it, they have not failed to mix imagination with history. From the policy of the cranes, they say, we are to look for an idea of the most perfect republic amongst ourselves; from their tenderness to their decrepit parents, which they take care to nourish, to cherish, and support when flying, we are to learn lessons of filial piety; but particularly from their conduct in fighting with the pigmies of Ethiopia, we are to receive our maxims in the art of war. In early times, the history of Nature fell to the lot of poets only, and certainly none could describe it so well; but it is a part of their province to embellish also; and when this agreeable science was claimed by a more sober class of people, they were obliged to take the accounts of things as they found them; and, in the present instance, fable ran down blended with truth to posterity.

In these accounts, therefore, there is some foundation of truth; yet much more has been added by fancy. The crane is certainly a very social bird, and they are seldom seen alone. Their usual method of flying or sitting is in flocks of fifty or sixty together; and while a part feed, the rest stand like sentinels upon duty. The fable of their supporting their aged parents, may have arisen from their strict connubial affection; and as for their fighting with the pigmies, it may not be improbable but that they have boldly withstood the invasions of monkeys coming to rob their nests; for in this case, as the crane lives upon vegetables, it is not probable that it would be the first aggressor.

However this be, the crane is a wandering, sociable bird, that for the most part, subsists upon vegetables; and is known in every country of Europe, except our own. There is no part of the world, says Bellonius, where the fields are cultivated, that the crane does not come in with the husbandman for a share in the harvest. As they are birds of passage, they are seen to depart, and return regularly at those seasons when their provision invites or repels them. They generally leave Europe about the latter end of autumn, and return in the beginning of summer. In the inland parts of the continent, they are seen crossing the country in flocks of fifty or a hundred, making from the northern regions towards the south. In these migrations, however, they are not so resolutely bent upon going forward, but that if a field of corn offers in their way, they will stop awhile to regale upon it: on such occasions they do incredible damage, chiefly in the night; and the husbandman, who lies down in joyful expectation, rises in the morning to see his fields laid entirely waste by an enemy, whose march is too swift for his vengeance to overtake.

Our own country is free from their visits; not but that they were formerly known in this island, and held in great estimation for the delicacy of their flesh; there was even a penalty upon such as destroyed their eggs; but, at present, they never go so far out of their way.[1] Cultivation and populousness go hand in hand; and though our fields may offer them a greater plenty, yet it is so guarded that the birds find the venture greater than the enjoyment; and probably we are much better off by their absence than their company. Whatever their flesh might once have been, when, as Plutarch tells us, cranes were blinded and kept in coops, to be fattened for the tables of the great in Rome; or, as they were brought up, stuffed with mint and rue, to the tables of our nobles at home; at present, they are considered all over Europe as wretched eating. The flesh is fibrous and dry, requiring much preparation to make it palatable; and even after every art, it is fit only for the stomachs of strong and labouring people.

[1] They are still, though very rarely, to be seen in this country. A crane was killed in Oxfordshire, in December, 1830.

The cold Arctic region seems to be this bird's favourite abode. They come down in the more southern parts of Europe, rather as visitants than inhabitants: yet it is not well known in what manner they portion out their time, to the different parts of the world. The migrations of the fieldfare or thrush, are obvious and well known; they go northward or southward, in one simple track; when their food fails them here, they have but one region to go to. But it is otherwise with the crane; he changes place, like a wanderer: he spends the autumn in Europe; he then flies off, probably to some more southern climate, to enjoy a part of the winter; returns to Europe in the spring; crosses up to the north in summer; visits those lakes that are never dry; and then comes down again, to make depredations upon our cultivated grounds, in autumn. Thus, Gesner assures us, that the cranes usually begin to quit Germany, from about the eleventh of September to the seventeenth of October; from thence they are seen flying southward by thousands; and Redi tells us, they arrive in Tuscany a short time after. There they tear up the fields, newly sown, for the grain just committed to the ground, and do great mischief. It is to be supposed, that, in the severity of winter, they go southward, still nearer the line. They again appear in the fields of Pisa, regularly about the twentieth of February, to anticipate the spring.

In these journeys, it is amazing to conceive the heights to which they ascend when they fly. Their note is the loudest of all other birds; and that is often heard in the clouds, when the bird itself is entirely unseen. As it is light for its size, and spreads a large expanse of wing, it is capable of floating at the greatest height, where the air is lightest; and as it secures its safety, and is entirely out of the reach of man, it flies in tracts which would be too fatiguing for any other birds to move forward in.

In these aerial journeys, though unseen themselves, they have the distinctest vision of every object below. They govern and direct their flight by their cries; and exhort each other to proceed or to descend, when a fit opportunity offers for depredation. Their voice, as was observed, is the loudest of all the feathered tribe; and its peculiar clangour arises from the very extraordinary length and contortion of the windpipe. In quadrupeds, the windpipe is short, and the glottis, or cartilages that form the voice, are at that end of it which is next the mouth; in water-fowl, the windpipe is longer, but the cartilages that form the voice are at the other end, which lies down in their belly. By this means they have much louder voices, in proportion to their size, than any other animal whatever; for the note when formed below, is reverberated through all the rings of the windpipe, till it reaches the air. But the voice of the duck or the goose, is nothing to be compared to that of the crane, whose windpipe is not only made in the same manner with theirs, but is above twenty times as long. Nature seems to have bestowed much pains in lengthening out this organ. From the outside, it enters through the flesh into the breast-bone, which hath a great cavity within to receive it. There being thrice reflected, it goes out again at the same hole, and so turns down to the lungs, and thus enters the body a second time. The loud clangorous sound which the bird is thus enabled to produce, is, when near, almost deafening: however, it is particularly serviceable to the animal itself, either during its migrations, or its stay; by it the flock is encouraged in their journeys; and if, while they are feeding, which is usually performed in profound silence, they are invaded on any side, the bird that first perceives the danger is sure to sound the alarm, and all are speedily upon the wing.

As they rise but heavily, they are very shy birds, and seldom let the fowler approach them. Their depredations are usually made in the darkest nights; at which time they enter a field of corn, and trample it down, as if it had been crossed over by a regiment of soldiers. On other occasions, they choose some extensive solitary marsh, where they range themselves all day, as if they were in deliberation; and not having that grain which is most to their appetites, wade the marshes for insects and other food, which they can procure with less danger.

Corn is their favourite food; but there is scarcely any other that comes amiss to them. Redi, who opened several, found the stomach of one full of the herb called *dandelion*: that of another was filled with beans; a third had a great quantity of clover in its stomach: while that of two others was filled with earth-worms and beetles; in some he found lizards and sea-fish; in others, snails, grass, and pebbles, swallowed perhaps for medicinal purposes. It seems, therefore, that these birds are easily supplied; and that they are noxious to corn-fields but on some particular occasions.

In general it is a peaceful bird, both in its own society, and with respect to those of the forest. Though so large in appearance, a little falcon pursues, and often disables it. The method is, with those who are fond of hawking, to fly several hawks together against it; which the crane endeavours to avoid, by flying up perpendicularly, till the air becomes too thin to support it any higher. The hawk, however, still bears it company; and though less fitted for floating in so thin a medium,

yet, possessed of greater rapidity, it still gains the ascendancy. They both often rise out of sight; but soon the spectator, who keeps his eye fixed above, perceives them, like two specks, beginning to appear: they gather on his eye for a little space, and shortly after come tumbling perpendicularly together, with great animosity on the side of the hawk, and a loud screaming on that of the crane. Thus driven to extremity, and unable to fly, the poor animal throws itself upon its back, and, in that situation, makes a most desperate defence, till the sportsman coming up, generally puts an end to the contest with its life.

It was once the barbarous custom to breed up cranes to be thus baited; and young ones were taken from the nest, to be trained up for this cruel diversion. It is an animal easily tamed; and, if we can believe Albertus Magnus, has a particular affection for man. This quality, however, was not sufficient to guard it from being made the victim of his fierce amusements. The female, which is easily distinguished from the male, by not being bald behind as he is, never lays above two eggs at a time; being like those of a goose, but of a bluish colour. The young ones are soon fit to fly, and then the parents forsake them to shift for themselves; but, before this time, they are led forth to the places where their food is most easily found. Though yet unfledged, they run with such swiftness that a man cannot easily overtake them. We are told, that as they grow old, their plumage becomes darker; and as a proof of their longevity, Aldrovandus assures us, that a friend of his kept one tame for above forty years.

Whatever may have been the disposition of the great, the vulgar of every country, to this day, bear the crane a compassionate regard. It is possible the ancient prejudices in its favour, which once having been planted are eradicated but slowly, may still continue to operate. In some countries, it is considered as a heinous offence to kill a crane; and though the legislature declines to punish, yet the people do not fail to resent the injury. The crane, they, in some measure, consider as the prophet of the season: upon its approach or delay they regulate the periods of their rural economy. If their favourite bird comes early in the season, they expect a plentiful summer; if he is slow in his visits, they then prepare for an unfavourable spring. Whatever wisdom there may be in despising the prejudices of the vulgar, there is but little in condemning them. They have generally had their origin in good motives; and it should never be our endeavours to suppress any tender emotions of friendship or pity in those hard breasts that are, in general, unsusceptible of either.

CHAP. III.

THE STORK.[1]

If we regard the Stork externally only, we shall be very apt to confound it with the crane.

[1] In the methodical arrangements of Ray and Brisson the Storks formed a distinct genus from the herons and the cranes, with which, and with various other less closely allied groups, they were united in the Linnean system of classification. Later naturalists have, however, seen the necessity of reverting to the older method, and of again separating these groups, which form in the arrangement proposed by Mr Vigors two families, distinguished by well marked characters, and each comprehending several genera of considerable numerical extent. The first of these families is the Grudæ, which comprise the cranes, the trumpeter, and other nearly related genera, distinguished by the comparative shortness and obtuseness of their bill, and the slight degree of palmation exhibited by their feet, which are smaller in proportion and consequently better adapted to the terrestrial habits of these birds, as the bill is to their vegetable food. The second is the Ardeidæ, whose produced and generally pointed bill, and long, slender and more deeply webbed toes, are equally well suited to their aquatic habits, and to the nature of the food, chiefly fishes and reptiles, on which they subsist. In the latter family are comprehended not only the Storks and the Herons, but also the spoonbills, the Ibis, and several other groups remarkable as well for the singularity of their forms, as for the peculiarity of their manners, and the interesting nature of many of the facts connected with their history, both as regards themselves and with reference to the services which they actually render, or have been supposed to render to mankind.

The distinguishing characters of the genus which at present engages our attention consist in a long straight beak, broad at the base, regularly narrowing to the point, opening to a moderate extent, and unimpressed on its upper surface either with lateral furrows or with a nasal pit; nostrils in the form of a longitudinal fissure, situated near the base of the bill and directed upwards; tongue extremely short; eyes surrounded by a naked skin; wings broad, expanding to a great extent, and prolonged posteriorly beyond the extremity of the tail; legs reticulated with hexagonal scales, of which the uppermost are the largest; web between the two outer of the anterior toes much more developed than that which is found at the base of the inner; posterior toe on the same level with the anterior ones; and claws broad, flat, and obtuse, approaching in form to the nails of man, and scarcely overlapping the extremities of the toes.

The species thus characterised are especially remarkable for the extent and regularity of their migrations, which are chiefly determined by the nature of their food. This consists of various kinds of garbage, of worms and insects, fishes and reptiles, and among the latter more particularly of frogs. At the approach of the colder season, when these animals begin to conceal themselves in holes, in order to pass the winter in a state of torpor, the storks are driven by the failure of their usual means of subsistence to seek a more temperate climate, in which the same scarcity of food is not likely to be felt; but they constantly return northwards with the return of spring. The most common and the most celebrated among them is *the White Stork*, (see Plate XIX. fig. 7.) which generally passes its winters in the north of Africa, and more particularly in Egypt, and migrates during the summer season to France and Holland, Sweden, Germany, Poland, and sometimes even Russia, but is very

It is of the same size ; it has the same formation as to the bill, neck, legs, and body, except that it is something more corpulent. Its differences are but very slight ; such as the colour, which, in the crane, is ash and black, but in the stork is white and brown. The nails of the toes of the stork also are very peculiar, not being clawed like those of other birds, but flat like the nails of a man.

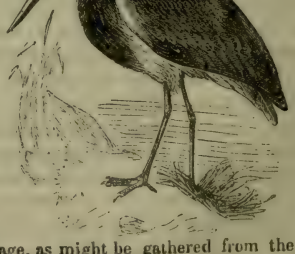
These, however, are but very slight differ-

rarely met with in England. It is rather larger than the black stork, measuring more than three feet from the extremity of the bill to the tip of the tail, and standing about the same height from the ground to the top of its head. Its bill, which is usually of an orange red, measures from seven to eight inches in length ; the naked and wrinkled skin surrounding its eyes is nearly of the same colour, but generally of a duskier hue ; and its legs are also red. The greater part of its plumage is of a clear white, which is however relieved by the striking contrast of the feathers covering the lower part of the shoulders, the larger wing-coverts, and the quill-feathers, thirty in number, all of which are of a glossy black, with a slight metallic reflection. When fully expanded the extent of the wings exceeds six feet, and in this state the eight or nine primary quill-feathers offer a very singular and indeed unique disposition, being separated from each other so as to leave a vacant space between. The feathers of the lower part of the neck are long, pendulous, and pointed. There is little distinction in any of these particulars between the male and the female ; but the young have a browner tinge in their wings, and their bills are of a duskier red.

These birds have in all ages been regarded with peculiar favour, amounting, in some countries, almost to veneration, partly on account of the services which they perform in the destruction of noxious animals, and in removing impurities from the surface of the earth, and partly on account of the mildness of their temper, the harmlessness of their habits, and the moral virtues with which imagination has delighted to invest them. Among the ancient Egyptians the stork was regarded with a reverence inferior only to that which, for similar causes, was paid to the sacred Ibis, considered, and with some show of reason, as one of the tutelary divinities of the land. The same feeling is still prevalent in many parts of Africa and the East ; and even in Switzerland and in Holland something like superstition seems to mingle, in the minds of the common people, with the hospitable kindness which a strong conviction of its utility disposes them to evince towards this favourite bird. In the latter country more particularly, the protection which is accorded to it is no more than it fairly deserves as the unconscious instrument by which the dikes and marshes are relieved from a large portion of the enormous quantity of reptiles engendered by the humidity and fertility of the soil.

On the other hand, the white stork appears to be influenced by the same friendly feelings towards man. Undismayed by his presence, it builds its nest upon the house-top, or on the summits of the loftiest trees in the immediate neighbourhood of the most frequented places. It stalks perfectly at its ease along the busy streets of the most crowded town, and seeks its food on the banks of rivers or in fens in close vicinity to his abode. In numerous parts of Holland its nest, built on the chimney-top, remains undisturbed for many succeeding years, and the owners constantly return with unerring sagacity to the well known spot. The joy which they manifest on again taking possession of their deserted dwelling, and the attachment which they testify towards their benevolent hosts, are familiar in the mouths of every one. Their affection for their young is one of the most remarkable traits in their character. It is almost superfluous to repeat the history of the female which, at the conflagration of Delft, after repeated and unsuccessful attempts to carry off her young, chose rather to perish with them in the general ruin than to leave them to their fate: and there are many other and well authenticated proofs of a similar disposition. They generally lay from two to four eggs, of a dingy yellowish white, rather longer than those of the goose, but not so broad. The incubation lasts for a month, the male sharing in the task during the absence of the female in search of food. When the young birds are hatched, they are carefully fed by their parents, who watch over them with the closest anxiety. As soon as they become capable of flying, the parents exercise them in it by degrees, carrying them at first upon their own wings, and then conducting them in short circular flights around their nest. When in search of food, the stork is commonly seen in its usual attitude of repose, standing upon one leg, with its long neck bent backwards, its head resting on its shoulder, and its eye steadily fixed. Its motions are slow and measured, the length of its steps corresponding with that of its legs. In flight its head and neck are directed straight forwards, and its legs extended backwards ; an awkward and apparently constrained position, but that which is best calculated for enabling it to cleave the air with rapidity. The large extent of its wings and the comparative lightness of its body are also admirably adapted to the lofty pitch at which it flies, and to its long continuance upon the wing. The storks generally migrate about the beginning of August, and the preparations for their departure usually occupy several weeks. They appear gradually to assemble in one spot from the whole of the surrounding district to the number of many hundreds, making when they meet that peculiar clattering with their beaks, which appears to serve them in the place of voice. As soon as their number is completed, the entire body mount at once into the air, without noise or confusion, and are speedily lost sight of in the loftiness of their flight. Their departure has rarely been witnessed by scientific observers ; and many incredible stories have consequently been told respecting it. They return to Europe in smaller bands in March and April.

The *Black Stork* resembles the White in form and proportions, but is somewhat smaller in size ; and the hue



of its plumage, as might be gathered from the epithets applied to the two birds, is very different. But these epithets, if taken strictly, are far from being correct ; the White Stork having, as we have seen, a portion of its plumage black ; and the Black exhibiting a variety of shades, of which, however, that from which it derives its name is the most predominant. Its bill, like that of the former bird, is full seven inches in length, and of a dusky red, approaching to orange ; as are also the legs and toes. The colour of the naked skin surrounding the eyes is dull red, and that of the irides hazel. On the head, neck, upper surface of the body and wings,

ences; and its true distinctions are to be taken rather from its manners than its form. The crane has a loud piercing voice; the stork is silent, and produces no other noise than the clacking of its under-chap against the upper: the crane has a strange convolution of the wind-pipe through the breast-bone; the stork's is formed in the usual manner: the crane feeds mostly upon vegetables and grain; the stork preys entirely upon frogs, fishes, birds, and serpents: the crane avoids towns and populous places; the stork lives always in or near them: the crane lays but two eggs; and the stork generally four. These are distinctions fully sufficient to mark the species, notwithstanding the similitude of their form.

Storks are birds of passage, like the former; but it is hard to say whence they come, or whither they go. When they withdraw from Europe, they all assemble on a particular day, and never leave one of their company behind them. They take their flight in the night; which is the reason the way they go has never been observed. They generally return into Europe in the middle of March, and make their nests on the tops of chimneys and houses, as well as of high trees. The females lay from two to four eggs, of the size and colour of those of geese; and the male and female sit upon them by turns. They are a month in hatching; and when their young are excluded, they are particularly solicitous for their safety.

As the food of these birds consists, in a great measure, of frogs and serpents, it is not to be wondered at that different nations have paid them a particular veneration. The Dutch are very solicitous for the preservation of the stork in every part of their republic. This bird seems to have taken refuge among their towns; and builds on the tops of their houses without any molestation. There it is seen resting familiarly in the streets, and protected as well by the laws as the prejudices of the people. They have even got an opinion that it will only live in a republic; and that story of its filial piety, first falsely propagated of the crane, has, in part, been ascribed to the stork. But it is not in republics alone that the stork is seen to reside, as there are few towns on the continent, in low marshy situations, but have the stork as an inmate among them; as well the despotic princes of Germany, as the little republics of Italy.[1]

The stork seems a general favourite even among the moderns; but with the ancient Egyptians their regard was carried even to adoration. This enlightened people, who worshipped the Deity in his creatures, paid divine honours to the ibis, as is universally known. It has been usually supposed that the ancient ibis is the same with that which

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the feathers are of a deep glossy black, intermingled with varying shades and reflections of violet and green, which becomes more strongly marked on the back and wings. Those of the whole under surface from the bottom of the neck to the base of the tail are white. The tail itself is black. The wings are extremely long, and so powerful as to raise the bird, in its flights and migrations, to such a height in the air as to be almost invisible to the human eye. Like the foregoing species, the black stork is a migratory bird, seeking the more southern parts of Europe during the inclemency of winter. In the spring it advances to a much higher latitude than the white, visiting even Russia and Siberia, and passing over Sweden towards the north in considerable numbers. But it seldom comes so far westward as the other, being almost unknown in Holland, although common in the eastern departments of France and throughout the whole of Germany. A solitary instance of its occurrence in Great Britain fell under the notice of the late Colonel Montagu, and forms the subject of an interesting paper in the twelfth volume of the Linnean Transactions. The character of the black stork is in one respect diametrically opposed to that of the white. Instead of domesticating itself as it were with man, it shuns his society and makes its temporary dwelling in the most secluded spots, frequenting impenetrable morasses or the banks of such rivers and lakes as are seldom disturbed by the presence of intruders, and building its nest on the summits of the loftiest pines. Its food is exactly similar to that of its more social fellow; and their manners, except in this peculiar sullenness on the part of the black stork, closely correspond. It submits itself with perfect resignation to captivity, never using its powerful bill as a weapon of offence against its companions. It appears to have no other voice than the clattering sound which it produces by the snapping of its mandibles.—*Zoological Society Gardens.*

[1] In Bagdad, and some other of the more remote cities of Asiatic Turkey, the nests of storks present a very remarkable appearance. The *minars*, or towers of the mosques, at Constantinople, and most other parts of Turkey, are tall, round pillars, surmounted by a very pointed cone; but at Bagdad, the absence of this cone enables these birds to build their nests upon the summit; and as the diameter of the nest generally corresponds with that of the minar, it appears as a part of it, and a regular termination to it. The curious effect is not a little increased by the appearance of the bird itself in the nest, which thus, as part of the body and its long neck are seen above the edge, appears the crowning object of the pillar. The Turks hold the bird in more than even the usual esteem, which may be partly attributed to its gesticulations, which they suppose to resemble some of their own attitudes of devotion. Their name for the stork is *Hadji Lug-lug:* the former word, which is the honorary title of a pilgrim, it owes to its annual migrations, and its apparent attachment to their sacred edifices. The latter portion of the denomination, "lug-lug," is an attempt to imitate the noise which the bird makes. The regard of the Turks is so far understood and returned by the intelligent stork, that, in cities of mixed population, it rarely or never builds its nest on any other than a Turkish house. The Rev. J. Hartley, in his "Researches in Greece and the Levant," remarks:—"The Greeks have carried their antipathy to the Turks to such a pitch, that they have destroyed all the storks in the country. On inquiring the reason, I was informed 'The stork is a Turkish bird: it never used to build its nest on the house of a Greek, but always on that of a Turk!' The tenderness which the Turks display towards the feathered tribe is indeed a pleasing trait in their character."

goes at present by the same name; a bird of the stork kind, of about the size of a curlew, all over black, with a bill very thick in the beginning, but ending in a point, for the better seizing its prey, which is caterpillars, locusts, and serpents. But however useful the modern ibis may be in ridding Egypt, where it resides, of the vermin and venomous animals that infest it; yet it is much doubted whether this be the same ibis to which the ancients paid their adoration. Maillet, the French consul at Cairo, observes, that it is very hard to determine what bird the ancient ibis certainly was, because there are cranes, storks, hawks, kites, and falcons, that are all equally enemies to serpents, and devour a vast number. He farther adds, that in the month of May, when the winds begin to blow from the internal parts of Africa, there are several sorts of birds that come down from Upper Egypt, from whence they are driven by the rains, in search of a better habitation, and that it is then they do this country such signal services. Nor does the figure of this bird, hieroglyphically represented on their pillars, mark it sufficiently to make the distinction. Besides, the modern ibis is not peculiar to Egypt, as it is to be seen but at certain seasons of the year; whereas we are informed by Pliny, that this bird was seen no where else. It is thought, therefore, that the true ibis is a bird of the vulture kind, described above, and called by some the *capon of Pharaoh*, which not only is a devourer of serpents, but will follow the caravans that go to Mecca, to feed upon the offal of the animals that are killed on the journey.[1]

[1] Perrault first introduced the erroneous notion that the ibis of antiquity was a species of Tantalus, in which he was followed implicitly by naturalists throughout the whole of the last century. Brisson, Buffon, Linnæus, and Latham, all united to give it currency; and the Tantalus ibis of the two latter authors was universally regarded as the sacred bird. Our adventurous countryman Bruce was the first to throw a doubt upon the authenticity of this determination, and to point out the identity between the figures represented on the ancient monuments, the mummies preserved in the Egyptian tombs, and a living bird common on the banks of the Nile and known to the Arabs by the name of Abou Hannes. But it was not until after the return of the French expedition from Egypt that the question was definitely settled by a careful anatomical comparison of the ancient mummies and recent specimens then brought home by Geoffroy-Saint-Hilaire and Savigny. From the examination of these materials, M. Cuvier was enabled to verify Bruce's assertion, and to restore to science a bird which after having formed for centuries the object of a nation's adoration, had fallen into oblivion, and was wholly unknown to modern naturalists. At the same time he pointed out those distinctive characters on which M. Lacepede founded the genus ibis, formally established by M. Cuvier himself in the first edition of his Regne Animal.

The ibis genus is characterized by a long and slender bill, nearly square at its base, where it is of less breadth than the head, almost straight for about one half of its length, and having the remaining part gradually curved downwards, blunt at its point and without any notch; nostrils situated near the base of the bill at the commencement of a groove which is continued along each side of its upper surface as far as to its point; the head, and sometimes the neck, devoid of feathers to an extent varying in the different races; wings of moderate length; tarsi slender; and toes webbed at the base, the hinder one placed somewhat above the level of the others but being of sufficient length to rest upon the earth. In many of these characters we observe a considerable deviation from those of the storks and other typical examples of the family with which the ibis is associated, and a marked approach to the curlews. From the natural habits and organization of the ibis, confirmed by analogy, and further corroborated by the testimony of the modern Egyptians, it does not appear that it feeds upon reptiles. We must, then, look for other reasons than the destruction of serpents, for the veneration paid to the ibis by the ancient Egyptians, who admitted it even into their temples, and prohibited the killing of it, under pain of death. In a country, where the people, very ignorant, were governed only by superstitious ideas, it was natural that fictions should have been imagined, to express with energy the happy influences of that phenomenon which every year attracts the ibis into Egypt, and retains it there. Its constant presence at the epoch of that inundation, which annually triumphs over all the sources of decay, and assures the fertility of the soil, must have appeared to the priests and the persons at the head of government admirably calculated to make a lively impression on the minds of the people, to lead them to suppose supernatural and secret relations between the movements of the Nile and the sojourn of these inoffensive birds, and to consider the latter as the cause of effects exclusively owing to the overflow of the river. Besides the white and black ibis, another ibis, entirely black, was equally reverenced in Egypt, and embalmed in a similar manner. This one is more elegant and slender than the other in its external form, and its internal organs are also more contracted. M. Savigny has opened about twenty individuals of this species, and has found nothing in their very narrow gizzard, but small fluviatile shells, with some debris of vegetables, which probably enveloped the shells at the moment in which they were swallowed, and cannot be considered as properly constituting any part of the aliment of these birds. The two species have a powerful and elevated flight. In this action the neck and feet are extended horizontally, and from time to time, the birds, all together, send forth deep and hoarse cries, more powerful in the white ibis than in the black. When these birds alight on lands which they have newly discovered, they remain crowded against each other, and may be seen for entire hours, occupied in searching the mud with their bills, advancing slowly, step by step, and never springing with rapidity like the curlews. The ibis does not nestle in Egypt.

The *Scarlet Ibis* (see Plate XIX. fig. 21.) is a native of America. These birds live almost always in flocks, and the old ones most frequently form distinct and sepa-

CHAP. IV.

OF THE BALEARIC AND OTHER FOREIGN CRANES.

Having ended the last chapter with doubts concerning the ibis, we shall begin this with

doubts concerning the Balearic Crane. Pliny has described a bird of the crane kind with a topping resembling that of the green woodpecker. This bird for a long time continued unknown, till we became acquainted with the birds of tropical climates, when one of the crane kind with a topping was brought into Europe, and described by Aldrovandus as Pliny's Balearic crane. Hence these birds, which have since been brought from Africa and the east in numbers, have received the name of Balearic cranes, but without any just foundation. The real Balearic crane of Pliny seems to be the lesser ash-coloured heron, with a topping of narrow white feathers; or perhaps the egret, with two long feathers that fall back from the sides of the head. The bird that we are about to describe under the name of the Balearic crane, was unknown to the ancients, and the heron or egret ought to be reinstated in their just title to that name.

When we see a very extraordinary animal, we are naturally led to suppose that there must be something also remarkable in its history, to correspond with the singularity of its figure. But it often happens that history fails on those occasions where we most desire information. In the present instance, in particular, no bird presents to the eye a more whimsical figure than this, which we must be content to call the *Balearic Crane*. It is pretty nearly of the shape and size of the ordinary crane, with long legs and a long neck, like others of the kind; but the bill is shorter, and the colour of the feathers of a dark greenish gray. The head and throat form the most striking part of this bird's figure. On the head is seen, standing up, a thick round crest, made of bristles, spreading every way, and resembling rays standing out in different directions. The longest of these rays are about three inches and a half, and they are all topped with a kind of black tassels, which give them a beautiful appearance. The sides of the head and cheeks are bare, whitish, and edged with red; while underneath the throat hangs a kind of bag or wattle, like that of a cock, but not divided into two, to give this odd composition a higher finishing, the eye is large and staring; the pupil black and big, surrounded with a gold-coloured iris, that completes the bird's very singular appearance.

From such a peculiar figure, we might be led to wish for a minute history of its manners; but of these we can give but slight information. This bird comes from the coast of Africa and the Cape de Verd islands. As it runs, it stretches out its wings, and goes very swiftly, otherwise its usual motion is very slow. In their domestic state, they walk very deliberately among other poultry, and suffer themselves to be approached (at least it was so with that I saw) by every spectator. They never roost in houses; but about night, when they are disposed to go to rest, they search out some high wall, on which they perch in the manner of a peacock. Indeed, they so much resemble that bird in manners and disposition, that some have described them by the name of the *sea peacock:* and Ray has been inclined to rank them in the same family. But though their voice and roosting be similar, their food, which is entirely upon greens, vegetables, and barley, seems to make some difference.

In this chapter of foreign birds of the crane kind, it will be proper to mention the Jabiru and the Jabiru Guacu, both natives of Brazil. Of these great birds of the crane kind we know but little, except the general outline of their figure, and the enormous bills which we often see preserved in the cabinets of the curious. The bill of the latter is red, and thirteen inches long; the bill of the former is black, and is found to be eleven. Neither of them, however, are of a size proportioned to their immoderate length of bill. The jabiru guacu is not above the size of a common stork, while the jabiru with the smallest bill exceeds the size of a swan. They are both covered with white feathers, except the head and neck, that are naked; and their principal difference is in the size of the body and the make of the bill; the lower

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rate bands. Their flight is rapid and sustained, but they do not put themselves in motion, except in the morning and evening, for the purpose of seeking their food, which consists of insects, shell animals, and small fishes, collected in the slime along the sea-coast, or at the mouths of rivers. During the greatest heat of the day and at night, they remain in sheltered places. The broods commence in January, and are concluded in May. They deposit their eggs, which are greenish, in large tufts of grass, or on little piles collected in the brush-wood. These ibides are spread throughout the warmest countries of America, and being not at all wild they are easily accustomed to live in houses. M. de la Borde mentions his having kept one for more than two years. It was fed with bread, raw or cooked meat, and fish; but it gave the preference to the entrails of fish and fowl. It would frequently occupy itself in seeking for earth-worms around the house, or following the labours of a negro gardener. In the evening, this bird would retire of itself into a poultry-house, where it reposed in the midst of a hundred fowl. It would perch on the highest bar, awake very early in the morning, fly round the house, and sometimes proceed to the sea-shore. It would attack cats with great intrepidity. It would have lived longer, had it not been accidentally killed, by a fowler, who mistook it for a wild curlew, when it was on a pond. All this shows the possibility of rearing in the warmer climates of Europe a bird which, according to the testimony of Laet, has already produced in a domestic state, and may, perhaps, one day be turned to good account. (For Wood Ibis, see Plate XIX. fig. 12.)

chap of the jabiru guacu being broad, and bending upwards.[1]

A bird still more extraordinary may be added to this class, call the *anhima*, and, like the two former, a native of Brazil. This is a water-fowl of the rapacious kind, and bigger than a swan. The head, which is small for the size of the body, bears a black bill, which is not above two inches long; but what distinguishes it in particular is a horn growing from the forehead as long as the bill, and bending forward like that of the fabulous unicorn of the ancients. This horn is not much thicker than a crow-quill, as round as if it were turned in a lathe, and of an ivory-colour. But this is not the only instrument of battle this formidable bird carries; it seems to be armed at all points; for at the fore-part of each wing, at the second joint, spring two straight triangular spurs, about as thick as one's little finger: the foremost of these goads or spurs is above an inch long; the hinder is shorter, and both of a dusky colour. The claws also are long and sharp; the colour is black and white; and they cry terribly loud, sounding something like *Vyhoo, Vyhoo*. They are never found alone, but always in pairs; the cock and hen prowl together; and their fidelity is said to be such, that when one dies, the other never departs from the carcase, but dies with its companion. It makes its nest of clay, near the bodies of trees, upon the ground, of the shape of an oven.

One bird more may be subjoined to this class, not for the oddity of its figure, but the peculiarity of its manners. It is vulgarly called by our sailors the *buffoon bird*, and by the French the *demoiselle*, or *lady*. The same qualities have procured it these different appellations from two nations, who, on more occasions than this, look upon the same objects in very different lights. The peculiar gestures and contortions of this bird, the proper name of which is the *Numidian Crane*, (see Plate XX. fig. 1.) are extremely singular; and the French, who are skilled in the arts of elegant gesticulation, consider all its motions as lady-like and graceful. Our English sailors, however, who have not entered so deeply into the dancing art, think, that while thus in motion, the bird cuts but a very ridiculous figure. It stoops, rises, lifts one wing, then another, turns round, sails forward, then back again; all which highly diverts our seamen; not imagining, perhaps, that all these contortions are but the awkward expression, not of the poor animal's pleasures, but its fears.

It is a very scarce bird; the plumage is of a leaden gray; but it is distinguished by fine white feathers, consisting of long fibres, which fall from the back of the head, about four inches long; while the fore-part of the neck is adorned with black feathers, composed of very fine, soft, and long fibres, that hang down upon the stomach, and give the bird a very graceful appearance. The ancients have described a buffoon bird; but there are many reasons to believe that theirs is not the Numidian crane. It comes from that country from whence it has taken its name.[2]

CHAP. V.

OF THE HERON AND ITS VARIETIES.[3]

Birds of the Crane, the Stork, and the Heron kind, bear a very strong affinity to each

[1] The *American Jabiru* is described by Azara under the name of *Collier Rouge*, and is called in Paraguay *Aiaiai*. It also inhabits Brazil, where it is named *Jabiru Guacu*, and is found in some other parts of South America. It is the *Negro* of the Hollanders, and the *Touyouyou* of the native tribes of French Guiana. It is one of the largest and strongest of shore-birds. It is mounted on very high stilts, and its body is as bulky and more elongated than that of the swan. The skin of the neck is wrinkled, and so flaccid that it depends like the dew-lap of a cow. This circumstance has given rise to the name of *Jabiru*, which in the language of the Guaranis signifies any thing inflated by the wind. The legs, very robust, are covered with large scales, and denuded of feathers for about the space of six inches. The jabirus constantly inhabit the humid grounds of South America, and are found in considerable abundance in the inundated savannahs of Guiana. They never quit their sojourn but to rise slowly into the heights of the atmosphere, where they support themselves for a very long time. These birds are voracious, and live only on fish and reptiles. They construct, on lofty trees, with long branches carefully interlaced, a spacious nest, in which the female deposits but one or two eggs. The young are fed with fish until they are strong enough to descend from the nest, and are defended by the parents with great courage. This nest is said to serve for several broods. The jabirus appear to be less wild in Guiana than in Paraguay. Bajon tells us that in 1773 a little negro contrived, by merely concealing his face with the branch of a tree, to approach a young one that had almost acquired its full growth, sufficiently near to seize it by the legs and catch it. The flesh of the old is hard and oily; but that of the young is tender, and tolerably good eating. (For Senegal Jabirus, see Plate XX. fig. 2.)

[2] M. de Savigny, in his observations on the system of the birds of Egypt and Syria, demonstrates, with much acumen, that the bird in question here is the *Crex* of the Greeks; and he also mentions that it is the *Bibio*, or *Grus*, or *Balearica*, and *Grus Minor*, of the Latins, though ornithologists place these denominations in the synonymy of the preceding species. These birds are found in various parts of Africa and Asia, in the interior of the countries of the Cape of Good Hope, but more particularly in the ancient Numidia; and they are observed to arrive in Egypt at the epoch of the inundation of the Nile. Some are also found on the southern coasts of the Black Sea, and the Caspian; but it is invariably marshy places which they frequent. They feed indifferently on grains, insects, worms, shell-mollusca, and even small fishes, which they catch with great dexterity. Their cry resembles the clamorous tones of the crane, but is much more feeble, and sharper.

[3] Cranes are distinguished by having the head bald;

other: and their differences are not easily discernible. As for the crane and the stork, they differ rather in their nature and internal conformation, than in their external figure; but still they may be known asunder, as well by their colour as by the stork's claws, which are very peculiar, and more resembling a man's nails than the claws of a bird. The heron may be

Storks have the orbits round the eyes naked; and Herons have the middle claw serrated internally. Herons comprehend the species known under the names of Egrets, Bitterns, Crab-eaters, &c. In the genus Ardea, now limited to the Herons and Bitterns, the bill is considerably longer than the head, sharp at the point, straight or very slightly curved, compressed laterally, cleft to the very base, and frequently armed at the edges with sharp denticulations; the upper mandible is marked on either side by a longitudinal groove, in which the linear nostrils are perforated near the base of the bill; from the bill to the eyes extends a space destitute of feathers; the tarsi are long and covered with large scales; the legs naked for some distance above the knee-joints; the toes long and slender, the outer one united to the middle by a membranous expansion, and the posterior attached so low down as to allow of its resting its whole length upon the ground; the anterior claws of moderate length, slightly curved and pointed, with a denticulated dilatation on the inner side of that of the middle toe; the posterior claw very long, arched, and pointed; and the wings long, with the first quill-feathers shorter than the two succeeding ones, which are the longest of the series. Thus restricted, the genus is extremely numerous; for M. Vieillot states it to be composed of no fewer than eighty species. These are distributed by M. Cuvier into six sections or subdivisions, among which the true herons are principally distinguished by the great length of their legs and neck, the long pendant plumes of the lower part of the neck, and the perfectly straight direction of the bill.

The *Common Heron* is, as its name implies, one of the most frequent and best known species of the group.



It is about three feet four inches in length, measuring from the end of the anterior toes to the extremity of the bill; from the bill to the tail it measures nearly three feet, of which the tail forms about eight inches; and the expanse of its wings exceeds five feet. It does not, however, weigh more than three pounds and a half, and its buoyancy in flight is consequently very considerable. The general colour of the whole upper surface of the bird is an ashy gray with somewhat of a bluish tinge. This is deeper on the back of the head, which is likewise ornamented with a dependant crest of narrow blackish feathers three inches or more in length, overshadowing the back of the neck. The upper part and sides of the neck are of a light gray, running into the pure ash-colour of the back, and the latter passing into a deeper shade of ashy gray upon the tail. The wing-coverts are nearly of the same colour, with a slight tinge of reddish; and the quill-feathers black with a bluish gloss. On the under parts the ground-colour of the plumage is a pure white, marked on the fore part of the neck and breast with large longitudinal black drops. The abdomen, upper part of the throat, and legs, are pure white. The naked space between the bill and eyes is of a grayish yellow; the iris is yellow; the bill bluish above and yellow beneath; the legs, which are bare of feathers for two or three inches above the knees, are somewhat flesh-coloured in their upper part and grayish brown below; and the claws black. The middle toe, with the addition of its claw, does not measure more than four inches; and is consequently much shorter than the tarsus, which exceeds six inches in length. Beneath the anterior half of the bill, which is about five inches long, the skin is capable of considerable distention. There is little difference in the colours of the female; but the young bird has no crest on the head, and its back and wings are of a darker gray.

The herons may be regarded as birds of passage, but their stay and departure seems everywhere to be regulated by their means of procuring food. They are no where very abundant, although they are met with in almost every part of the northern and temperate regions of the old continent, and perhaps also in the new. In Europe they migrate as far northward as Drontheim, and are found even in Russia and Poland, but they are most common in England, France, and Holland. They build their nests, in numerous companies, on lofty trees, and more especially oaks, in the immediate neighbourhood of streams and marshes. The nest is of large dimensions, constructed externally of twigs, dry herbs, and reeds, and lined internally with feathers and wool. In this the female deposits her eggs, three or four in number, about the size of those of the common hen, but more elongated, and of a greenish brown colour without spots. The male does not share in the task of incubation; but flies abroad in search of food, while the female tends her charge at home. They are particularly fond of the society of ravens, but the latter often carry off their eggs; and the falcons, weasels, and martens, are dangerous enemies to their young. When the young are hatched, both parents assist in providing them with food until they are able to fly, and bring them abundance of fish for their support. But as soon as they become capable of a continued flight they are driven from the nest, and proceed each in a separate direction to seek its own subsistence wherever it may be most plentifully procured. The old birds quit their nests about the middle of August, and wander from stream to stream, and from lake to lake, forming themselves into gradually increasing bands as the colder season approaches. Towards the beginning of September they are often met with in companies of from twenty to thirty in a spot; but as soon as the frost sets in, they begin their migration to the southward, taking their flight by moonlight, like the cranes, but not with the same order and regularity. They return about the latter end of March, when the severity of the season is no longer to be dreaded. Some few, however, remain throughout the winter, especially when the weather is variable, and are occasionally seen, in company with the wild ducks, at the commencement of a sudden thaw. They usually disappear with the return of frost. Their food consists principally, like that of most of the birds of the wading order, of fresh-water fishes, but more particularly of the young fry of carp and trout. In pursuit of these they wade gently into the water, where the fish abound, and stand in it up to their knees, (or rather to their knee, for they rest only on one foot,) with their heads drawn in by the folding of their long necks upon the breast, quietly watching

distinguished from both, as well by its size, which is much less, as by its bill, which in proportion is much longer; but particularly by the middle claw on each foot, which is toothed like a saw, for the better seizing and holding its slippery prey. Should other marks fail, however, there is anatomical distinction, in which herons differ from all other birds; which is, that they have but one cœcum, and all other birds have two.

Of this tribe, Brisson has enumerated not less than forty-seven sorts, all differing in their size, figure, and plumage; and with talents adapted to their place of residence, or their peculiar pursuits. But, how various soever the heron kind may be in their colours or their bills, they all seem possessed of the same manners, and have but one character of cowardice, rapacity, and indolence, yet insatiable hunger. Other birds are found to grow fat by an abundant supply of food; but these, though excessively destructive and voracious, are ever found to have lean and carrion bodies, as if not even plenty were sufficient for their support.

The common heron is remarkably light, in proportion to its bulk, scarcely weighing three pounds and a half, yet it expands a breadth

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the approach of their prey. It has been remarked, not merely by the vulgar, but by observers deserving of implicit confidence, that the fish generally swarm around them in sufficient numbers to afford them a plentiful supply; and this has been commonly accounted for on the supposition that their legs communicate a peculiar odour to the water, which entices the fish to their destruction. But M. Bechtein, who vouches for the fact as one which he had seen innumerable times, suspects that the source of attraction is in the excrements of the bird, which it lets fall into the water, and which the fish, as is proved by experiment, devour with the utmost avidity. The time of fishing is usually before sunrise or after sunset. They generally swallow their prey entire, and many stories are current of eels escaping alive through their intestines, and being a second time devoured by the voracious birds. Besides fishes, frogs form a considerable portion of their food, and in winter they are frequently compelled to content themselves with snails and worms, or, according to M. de Salerne, even with the duck-weed that floats upon the stagnant waters. At such times they occasionally become so emaciated as to appear to consist of little else than feathers and bones.

Herons are taken in various ways. Sometimes they are shot while fishing, or sweeping leisurely along the banks; but they are so shy that the sportsman can rarely get within gunshot of them. Occasionally a living fish is attached to a hook at the end of a line, and left to swim in the waters which they are known to frequent; and they are thus caught as it were by angling. When falconry was in fashion, hawking at the heron was regarded as the most noble of its branches; the powerful wings of the heron, unequalled by any bird of its size, enabling it to mount in the air to an almost incredible height, and thus to put the powers of the falcon to their proof. For this purpose it was customary to establish the herons in a proper situation, to which they were attached by precautions taken for providing them with necessaries. These heronries, as they were called, have now become extremely rare; but one of them may still be seen at Didlington in Norfolk, the seat of Colonel Wilson.

The heron, when taken young, readily becomes habituated to captivity; but the old birds generally refuse all sustenance, and perish of inanition. In former days, when it was necessary to procure such for the training of the hawks, it was usual, according to Sir J. Sebright, "to cram them with food, and to tie a piece of mat round their necks to prevent them from throwing it up again." Sometimes, however, the old birds have been known to become tame and even domesticated; and the same distinguished authority to whom we have just referred, mentions an instance that occurred within his own knowledge, in which, after recourse had been had to the operation of cramming and tying down the food, the bird "became so tame as to follow its master on the wing to the distance of some miles, to come into the house when called, and to take food from the hand."

The *Night Heron*, so called from the hoarse croaking which it utters during the night, is about twenty inches in length. The bill is three inches and three quarters long, slightly arched, strong, and black, inclining to yellow at the base; the skin from the beak round the eyes is bare, and of a greenish colour; irides yellow. A white line is extended from the beak over each eye; a black patch, glossed with green, covers the crown of the head and nape of the neck, from which three long narrow white feathers, tipped with brown, hang loose and waving; the hinder part of the neck, coverts of the wings, the sides and tail, are ash-coloured; throat white; fore part of the neck, breast, and belly, yellowish white or buff; the back black; the legs a greenish yellow. The female is nearly of the same size as the male; but she differs considerably in her plumage, which is less bright and distinct, being more blended with clay or dirty white, brown, gray, and rusty ash-colour; and she has not the delicate plumes that flow from the head of the male. The night-heron frequents the sea-shores, rivers, and inland marshes; and lives upon insects, slugs, frogs, reptiles, and fish. It remains concealed during the day, and does not roam abroad until the approach of night, when it is heard and known by its harsh, rough, and disagreeable cry, which is by some compared to the noise made by a person straining to vomit. Some ornithologists affirm, that the female builds her nest in trees; others, that she builds it on rocky cliffs; probably both accounts are right. She lays three or four white eggs.

Crested Purple Heron.—It inhabits Asia, and is two feet ten inches in length. The bill is brown, tipt with dusky brown, and is yellowish beneath; the crest is of a black colour; the orbits naked and yellowish; from the angle of the mouth to the hind head it has a black streak; the chin is white; upper half of the neck rufous, with three longitudinal black lines; the rest olive behind, and rufous at the sides, and reddish on the fore-part; the feathers are long, narrow, each marked with a black spot; a black band passes from the middle of the breast to the vent; the lower tail coverts are white, mixed with rufous and tipt with black; angles of the wings rufous; the quill feathers dusky; and the legs greenish; hind-head black; the crest pendant, consisting of two long feathers; the body is of an olive colour, and beneath it is purplish.

The smaller herons with shorter feet have been called *Crab-eaters*. The *Egrets* are herons, whose plumes on the lower part of the back are, at a certain period, long and attenuated. These plumes were formerly used to decorate the helmets of warriors; they are now applied to a gentler and better purpose, in ornamenting the head-dresses of the European ladies, and the turbans of the Persians and Turks.—*Supplement to the English edition of Cuvier.*

of wing, which is five feet from tip to tip. Its bill is very long, being five inches from the point to the base; its claws are long, sharp, and the middlemost toothed like a saw. Yet, thus armed as it appears for war, it is indolent and cowardly, and even flies at the approach of a sparrow-hawk. It was once the amusement of the great to pursue this timorous creature with the falcon: and heron-hawking was so favourite a diversion among our ancestors, that laws were enacted for the preservation of the species; and the person who destroyed their eggs was liable to a penalty of twenty shillings for each offence.

At present, however, the defects of the ill-judged policy of our ancestors, is felt by their posterity; for, as the amusement of hawking has given place to the more useful method of stocking fish-ponds, the heron is now become a most formidable enemy. Of all other birds, this commits the greatest devastation in fresh waters; and there is scarce a fish, though never so large, that he will not strike at and wound, though unable to carry it away. But the smaller fry are his chief subsistence; these, pursued by their larger fellows of the deep, are obliged to take refuge in shallow waters, where they find the heron a still more formidable enemy. His method is to wade as far as he can go into the water, and there patiently wait the approach of his prey, which, when it comes within sight, he darts upon with inevitable aim. In this manner he is found to destroy more in a week than an otter in three months. "I have seen a heron," says Willoughby, "that had been shot, that had seventeen carps in its belly at once, which he will digest in six or seven hours, and then to fishing again. I have seen a carp," continues he, "taken out of a heron's belly, nine inches and a half long. Several gentlemen who kept tame herons, to try what quantity one of them would eat in a day, have put several smaller roach and dace in a tub; and they have found him eat fifty in a day, one day with another. In this manner a single heron will destroy fifteen thousand carp in half a year."

So great are the digestive powers of this fresh-water tyrant, and so detrimental to those who stock ponds with fish. In general, he is seen taking his gloomy stand by the lake's side, as if meditating mischief, motionless, and gorged with plunder. His usual attitude on this occasion is to sink his long neck between his shoulders, and keep his head turned on one side, as if eyeing the pool more intently. When the call of hunger returns, the toil of an hour or two is generally sufficient to fill his capacious stomach; and he retires long before night to his retreat in the woods. Early in the morning, however, he is seen assiduous at his usual occupation.

But, though in seasons of fine weather the heron can always find a plentiful supply; in cold or stormy seasons, his prey is no longer within reach: the fish that before came into the shallow water, now keep in the deep; as they find it to be the warmest situation. Frogs and lizards also seldom venture from their lurking places; and the heron is obliged to support himself upon his long habits of patience, and even to take up with the weeds that grow upon the water. At those times he contracts a consumptive disposition, which succeeding plenty is not able to remove; so that the meagre glutton spends his time between want and riot, and feels alternately the extremes of famine and excess. Hence, notwithstanding the care with which he takes his prey, and the amazing quantity he devours, the heron is always lean and emaciated; and though his crop be usually found full, yet his flesh is scarcely sufficient to cover the bones.

The heron usually takes his prey by wading into the water; yet it must not be supposed that he does not also take it upon the wing. In fact, much of his fishing is performed in this manner; but he never hovers over deep waters, as there his prey is enabled to escape him by sinking to the bottom. In shallow places he darts with more certainty; for though the fish at sight of its enemy instantly descends, yet the heron, with his long bill and legs, instantly pins it to the bottom, and thus seizes it securely. In this manner, after having been seen with his long neck for above a minute under water, he rises upon the wing, with a trout or an eel struggling in his bill to get free. The greedy bird, however, flies to the shore, scarcely gives it time to expire, but swallows it whole, and then returns to fishing as before.

As this bird does incredible mischief to ponds newly stocked, Willoughby has given a receipt for taking him.—"Having found his haunt, get three or four small roach or dace, and having provided a strong hook with a wire to it, this is drawn just within-side the skin of the fish, beginning without-side the gills, and running it to the tail, by which the fish will not be killed, but continue for five or six days alive. Then having a strong line made of silk and wire, about two yards and a half long, it is tied to a stone at one end, the fish with the hook being suffered to swim about at the other. This being properly disposed in shallow water, the heron will seize upon the fish to its own destruction. From this method we may learn, that the fish must be alive, otherwise the heron will not touch them, and that this bird, as well as all those that feed upon fish, must be its own caterer; for they will not prey upon such as die naturally, or are killed by others before them."

Though this bird lives chiefly among pools and marshes, yet its nest is built on the tops of the highest trees, and sometimes on cliffs hanging over the sea. They are never in flocks when they fish, committing their depredations in solitude and silence; but in making their nests they love each other's society; and they are seen, like rooks, building in company with flocks of their kind. Their nests are made of sticks, and lined with wool; and the female lays four large eggs of a pale green colour. The observable indolence of their nature, however, is not less seen in their nestling than in their habits of depredation. Nothing is more certain, and I have seen it a hundred times, than that they will not be at the trouble of building a nest, when they can get one made by the rook, or deserted by the owl, already provided for them. This they usually enlarge and line within, driving off the original possessors, should they happen to renew their fruitless claims.

The French seem to have availed themselves of the indolence of this bird in making its nest; and they actually provide a place with materials fitted for their nestling, which they call *heronries*. The heron, which with us is totally unfit for the table, is more sought for in France, where the flesh of the young ones is in particular estimation. To obtain this the natives raise up high sheds along some fishy stream; and furnishing them with materials for the herons to nestle with, these birds build and breed there in great abundance. As soon as the young ones are supposed to be fit, the owner of the heronry comes, as we do into a pigeon-house, and carries off such as are proper for eating; and these are sold for a very good price to the neighbouring gentry. "These are a delicacy which," as my author says, "the French are very fond of, but which strangers have not yet been taught to relish as they ought." Nevertheless, it was formerly much esteemed as food in England, and made a favourite dish at great tables. It was then said that the flesh of a heron was a dish for a king; at present nothing about the house will touch it but a cat.

With us, therefore, as the heron, both old and young, is thought detestable eating, we seldom trouble these animals in their heights, which are for the most part sufficiently inaccessible. Their nests are often found in great numbers in the middle of large forests, and in some groves nearer home, where the owners have a predilection for the bird, and do not choose to drive it from its accustomed habitations. It is certain that by their cries, their expansive wings, their bulk, and wavy motion, they add no small solemnity to the forest, and give a pleasing variety to a finished improvement.

When the young are excluded, as they are numerous, voracious, and importunate, the old ones are for ever upon the wing to provide them with abundance. The quantity of fish they take upon this occasion is amazing, and their size is not less to be wondered at. I remember a heron's nest that was built near a school-house; the boys, with their usual appetite for mischief, climbed up, took down the young ones, sewed up their vents, and laid them in the nest as before. The pain the poor little animals felt from the operation increased their cries; and this but served to increase the diligence of the old ones in enlarging their supply. Thus they heaped the nest with various sorts of fish, and the best of their kind; and as their young screamed, they flew off for more. The boys gathered up the fish, which the young ones were incapable of eating, till the old ones at last quitted their nest; and gave up their brood, whose appetites they found it impossible to satisfy.

The heron is said to be a very long-lived bird; by Mr Keysler's account, it may exceed sixty years; and by a recent instance of one that was taken in Holland, by a hawk belonging to the Stadtholder, its longevity is again confirmed, the bird having a silver plate fastened to one leg, with an inscription, importing that it had been struck by the elector of Cologne's hawks thirty-five years before.

CHAP. VI.

OF THE BITTERN, OR MIRE-DRUM.



Those who have walked in an evening by the sedgy sides of unfrequented rivers, must remember a variety of notes from different water-fowl: the loud scream of the wild-goose, the croaking of the mallard, the whining of the lapwing, and the tremulous neighing of the jack-snipe. But of all those sounds, there is none so dismally hollow as the booming of

the bittern. It is impossible for words to give those who have not heard this evening-call an adequate idea of its solemnity. It is like the interrupted bellowing of a bull, but hollower, and louder, and is heard at a mile's distance, as if issuing from some formidable being that resided at the bottom of the waters.

The bird, however, that produces this terrifying sound, is not so big as a heron, with a weaker bill, not above four inches long. It differs from the heron chiefly in its colour, which is in general of a paleish yellow, spotted and barred with black. Its windpipe is fitted to produce the sound for which it is remarkable; the lower part of it dividing into the lungs, is supplied with a thin loose membrane, that can be filled with a large body of air, and exploded at pleasure. These bellowing explosions are chiefly heard from the beginning of spring to the end of autumn; and however awful they may seem to us, are the calls to courtship, or of connubial felicity.

From the loudness and solemnity of the note, many have been led to suppose, that the bird made use of external instruments to produce it, and that so small a body could never eject such a quantity of tone. The common people are of opinion, that it thrusts its bill into a reed, that serves as a pipe for swelling the note above its natural pitch; while others, and in this number we find Thomson the poet, imagine that the bittern puts its head under water, and then violently blowing produces its boomings. The fact is, that the bird is sufficiently provided by nature for this call; and it is often heard where there are neither reeds nor waters to assist its sonorous invitations.

It hides in the sedges by day, and begins its call in the evening, booming six or eight times, and then discontinuing for ten or twenty minutes, to renew the same sound. This is a call it never gives but when undisturbed, and at liberty. When its retreats among the sedges are invaded, when it dreads or expects the approach of an enemy, it is then perfectly silent. This call it has never been heard to utter when taken or brought up in domestic captivity; it continues under the control of man a mute forlorn bird, equally incapable of attachment or instruction. But though its boomings are always performed in solitude, it has a scream which is generally heard upon the seizing its prey, and which is sometimes extorted by fear.

This bird, though of the heron kind, is yet neither so destructive nor so voracious. It is a retired timorous animal, concealing itself in the midst of reeds and marshy places, and living upon frogs, insects, and vegetables; and though so nearly resembling the heron in figure, yet differing much in manners and appetites. As the heron builds on the tops of the highest trees, the bittern lays its nest in a sedgy margin, or amidst a tuft of rushes. The heron builds with sticks and wool; the bittern composes its simpler habitation of sedges, the leaves of water-plants, and dry rushes. The heron lays four eggs; the bittern generally seven or eight, of an ash-green colour. The heron feeds its young for many days; the bittern in three days leads its little ones to their food. In short, the heron is lean and cadaverous, subsisting chiefly upon animal food; the bittern is plump and fleshy, as it feeds upon vegetables, when more nourishing food is wanting.

It cannot be, therefore, from its voracious appetites, but its hollow boom, that the bittern is held in such detestation by the vulgar. I remember, in the place where I was a boy, with what terror this bird's note affected the whole village; they considered it as the presage of some sad event; and generally found or made one to succeed it. I do not speak ludicrously; but if any person in the neighbourhood died, they supposed it could not be otherwise, for the night-raven had foretold it; but if no body happened to die, the death of a cow or a sheep gave completion to the prophecy.

Whatever terror it may inspire among the simple, its flesh is greatly esteemed among the luxurious. For this reason, it is as eagerly sought after by the fowler, as it is shunned by the peasant; and, as it is a heavy-rising slow-winged bird, it does not often escape him. Indeed, it seldom rises but when almost trod upon, and seems to seek protection rather from concealment than flight. At the latter end of autumn, however, in the evening, its wonted indolence appears to forsake it. It is then seen rising in a spiral ascent, till it is quite lost from the view, making at the same time a singular noise, very different from its former boomings. Thus the same animal is often seen to assume different desires; and while the Latins have given the bittern the name of the star-reaching bird, (or the *stellaris*,) the Greeks, taking its character from its more constant habits, have given it the title of the *οκνος*, or the lazy bird.

CHAP. VII.

OF THE SPOONBILL, OR SHOVELLER.

As we proceed in our description of the crane kind, birds of peculiar forms offer, not entirely like the crane, and yet not so far different as to rank more properly with any other class. Where the long neck and stilt-legs of the crane are found, they make too

striking a resemblance not to admit such birds of the number; and though the bill, or even the toes, should entirely differ, yet the outlines of the figure, and the natural habits and dispositions, being the same, these are sufficient to mark their place in the general group of nature.

The *Spoonbill* is one of those birds which differs a good deal from the crane, yet approaches this class more than any other. The body is more bulky for its height, and the bill is very differently formed from that of any other bird whatever. Yet still it is a comparatively tall bird; it feeds among waters; its toes are divided; and it seems to possess the natural dispositions of the crane. The European spoonbill is of about the bulk of a crane; but as the one is above four feet high, the other is not more than three feet three inches. The common colour of those of Europe is a dirty white; but those of America are of a beautiful rose colour, or a delightful crimson. Beauty of plumage seems to be the prerogative of all the birds of that continent; and we here see the most splendid tints bestowed on a bird, whose figure is sufficient to destroy the effects of its colouring; for its bill is so oddly fashioned, and its eyes so stupidly staring, that its fine feathers only tend to add splendour to deformity. The bill, which in this bird is so very particular, is about seven inches long, and running out broad at the end, as its name justly serves to denote, it is there about an inch and a half wide. This strangely fashioned instrument in some is black; in others of a light gray; and in those of America, it is of a red colour, like the rest of the body. All round the upper chap there runs a kind of rim, with which it covers that beneath; and as for the rest, its cheeks and its throat are without feathers, and covered with a black skin.[1] A bird so oddly fashioned might be expected to possess some very peculiar appetites; but the spoonbill seems to lead a life entirely resembling all those of the crane kind; and Nature, when she made the bill of this bird so very broad, seems rather to have sported with its form, than to aim at any final cause for which to adapt it. In fact, it is but a poor philosophy to ascribe every capricious variety in nature to some salutary purpose: in such solutions we only impose upon each other, and often wilfully contradict our own belief. There must be imperfections in every being, as well as capacities of enjoyment. Between both, the animal leads a life of moderate felicity; in part making use of its many natural advantages, and in part necessarily conforming to the imperfections of its figure.

The shoveller chiefly feeds upon frogs, toads, and serpents; of which, particularly at the Cape of Good Hope, they destroy great numbers. The inhabitants of that country hold them in as much esteem as the ancient Egypt-

[1] The Spoonbills are voyaging birds, not very wild, and show no aversion to living in a state of captivity. They are found in almost all countries of the old world. In Europe they are seen but seldom in the interior parts, and are only passagery on some lakes or the banks of rivers. They frequent the marshy coasts of Holland, of Brittany, and of Picardy. They are also seen in Prussia, in Silesia, and in Poland, and in summer they advance as far as West Bothnia and Lapland. They are again to be found on the coasts of Africa, in Egypt, and at the Cape of Good Hope, where they are called *Slangen-wreeter*, that is, serpent-eaters. Commerson has seen them at Madagascar, where the islanders give them the name of *Funguli-am-bava*, which means spade-bill. The negroes in some districts call them *Vang-van*, and in others *Vourou-Doulou*, or birds of the devil.

The *White Spoonbill* is an occasional, but rare visitor of this country. They rise very high, and fly in waving lines. Their flesh is tolerably good eating, and is destitute of the oily taste which is peculiar to most shore birds.

The *Roseate Spoonbill* is an American species, and is the *Ajaja* of Brazil (Marcgrave,) and the *Tlauhquecul* of Fernandez, and *Guirapita* of the natives of Paraguay. Its dimensions are not so great as those of the spoonbill of the ancient continent. The plumage, in general, is of a beautiful rose colour, while the upper part of the wing and the tail-coverts, are of a lively red. Age, however, operates the same changes of colour in these spoonbills, as in the red curlew, and in the flamingo, which in their first years are almost completely white or gray. The bill and its membrane are of a yellowish-green, which becomes white when the bird is terrified.

The beak of the spoonbills is longer than that of the storks, and perfectly straight. Towards the extremity it expands into an oval disk of greater breadth than the remainder of the bill, and rounded at the point. In the adult bird, the cheeks are naked, and a tuft of long narrow feathers forms a crest on the back of the head. The tongue is short, triangular, and pointed; the throat capable of being dilated into a pouch; the legs long and covered with large reticulated scales; the toes four in number; and the claws short, narrow, and pointed.

The spoonbills usually frequent wooded marshes near the mouths of rivers, building in preference upon the taller trees, but where these are wanting taking up their abode among the bushes, or even among the reeds. The females usually lay three or four whitish eggs. They associate together, but not in any considerable numbers, and feed upon the smaller fishes and their spawn, shell-fish, reptiles, and other aquatic or amphibious animals. The form and flexibility of their bills are well adapted for burrowing in the mud after their prey; and the tubercles which are placed on the inside of their mandibles serve both to retain the more slippery animals and to break down their shelly coverings. Their internal conformation, which is in nearly every respect similar to that of the stork, is admirably suited to this kind of food. They have no proper voice, the lower larynx being destitute of the muscles by which sounds are produced, and their only means of vocal expression consist in the snapping of their mandibles, which they clatter with much precipitation when under the influence of anger or alarm. In captivity they are perfectly tame, living in peace and concord with the other inhabitants of the farm-yard, and rarely exhibiting any symptoms of wildness or desire of change. They feed on all kinds of garbage.

ians did their bird ibis: the shoveller runs tamely about their houses; and they are content with its society, as a useful, though a homely, companion. They are never killed; and, indeed, they are good for nothing when they are dead, for the flesh is unfit to be eaten.

This bird breeds, in Europe, in company with the heron, in high trees; and in a nest formed of the same materials. Willoughby tells us, that in a certain grove, at a village called Seven Huys, near Leyden, they build and breed yearly in great numbers. In this grove, also, the heron, the bittern, the cormorant, and the shag, have taken up their residence, and annually bring forth their young together. Here the crane kind seem to have formed their general rendezvous; and, as the inhabitants say, every sort of bird has its several quarter, where none but their own tribe are permitted to reside. Of this grove, the peasants of the country make good profit. When the young ones are ripe, those that farm the grove, with a hook at the end of a long pole, catch hold of the bough on which the nest is built, and shake out the young ones; but sometimes the nest and all tumble down together.

The shoveller lays from three to five eggs, white, and powdered with a few sanguine or pale spots. We sometimes see, in the cabinets of the curious, the bills of American shovellers, twice as big and as long as those of the common kind among us; but these birds have not yet made their way into Europe.

CHAP. VIII.

THE FLAMINGO.



The Flamingo has the justest right to be placed among cranes, and though it happens to be web-footed, like birds of the goose kind, yet its height, figure, and appetites, entirely remove it from that grovelling class of animals. With a longer neck and legs than any other of the crane kind, it seeks its food by wading among waters, and only differs from all of this tribe in the manner of seizing its prey; for as the heron makes use of its claws, the flamingo uses only its bill, which is strong and thick for the purpose, the claws being useless, as they are feeble, and webbed like those of water-fowl.

The flamingo is the most remarkable of all the crane kind, the tallest, bulkiest, and the most beautiful. The body, which is of a beautiful scarlet, is no bigger than that of a swan; but its legs and neck are of such an extraordinary length, that, when it stands erect, it is six feet six inches high. Its wings, extended, are five feet six inches from tip to tip; and it is four feet eight inches from tip to tail. The head is round and small, with a large bill, seven inches long, partly red, partly black, and crooked like a bow. The legs and thighs, which are not much thicker than a man's finger, are about two feet eight inches high; and its neck near three feet long. The feet are not furnished with sharp claws, as in others of the crane kind; but feeble, and united by membranes, as in those of the goose. Of what use these membranes are does not appear, as the bird is never seen swimming, its legs and thighs being sufficient for bearing it into those depths where it seeks for prey.

This extraordinary bird is now chiefly found in America; but it was once known on all the coasts of Europe. Its beauty, its size, and the peculiar delicacy of its flesh, have been such temptations to destroy or take it, that it has long since deserted the shores frequented by man, and taken refuge in countries that are as yet but thinly peopled. In those desert regions, the flamingos live in a state of society, and under a better polity than any other of the feathered creation.

When the Europeans first came to America, and coasted down along the African shores, they found the flamingos on several shores on either continent, gentle, and no way distrustful of mankind.[1] They had long been used to security, in the extensive solitudes they had chosen; and knew no enemies but those they could very well evade or oppose. The negroes and the native Americans were possessed but of few destructive arts for killing them at a distance; and when the bird perceived the arrow, it well knew how to avoid it. But it was otherwise when the Europeans first came among them; the sailors, not considering that the dread of fire-arms was totally un-

[1] Albin's New History of Birds.

known in that part of the world, gave the flamingo the character of a foolish bird, that suffered itself to be approached and shot at. When the fowler had killed one, the rest of the flock, far from attempting to fly, only regarded the fall of their companion in a kind of fixed astonishment; another and another shot was discharged; and thus the fowler often levelled the whole flock, before one of them began to think of escaping.

But at present it is very different in that part of the world; and the flamingo is not only one of the scarcest, but of the shyest birds in the world, and the most difficult of approach. They chiefly keep near the most deserted and inhospitable shores; near salt-water lakes and swampy islands. They come down to the banks of rivers by day; and often retire to the inland mountainous parts of the country at the approach of night. When seen by mariners in the day, they always appear drawn up in a long close line of two or three hundred together; and, as Dampier tells us, present at the distance of half a mile, the exact representation of a long brick wall. Their rank, however, is broken when they seek for food; but they always appoint one of the number as a watch, whose only employment is to observe and give notice of danger, while the rest are feeding. As soon as this trusty centinel perceives the remotest appearance of danger, he gives a loud scream, with a voice as shrill as a trumpet, and instantly the whole cohort are upon the wing. They feed in silence; but upon this occasion, all the flock are in one chorus, and fill the air with intolerable screamings.

From this it appears, that the flamingos are very difficult to be approached at present, and that they avoid mankind with the most cautious timidity; however, it is not from any antipathy to man that they shun his society, for in some villages, as we are assured by Labat, along the coasts of Africa, the flamingos come in great numbers to make their residence among the natives. There they assemble by thousands, perched on the trees, within and about the village; and are so very clamorous, that the sound is heard at near a mile's distance. The negroes are fond of their company; and consider their society as a gift of Heaven, as a protection from accidental evils. The French, who are admitted to this part of the coast, cannot, without some degree of discontent, see such a quantity of game untouched, and rendered useless by the superstition of the natives: they now and then privately shoot some of them, when at a convenient distance from the village, and hide them in the long grass, if they perceive any of the negroes approaching; for they would probably stand a chance of being ill used, if the blacks discovered their sacred birds thus unmercifully treated.

Sometimes, in their wild state, they are shot by mariners; and their young, which run excessively fast, are often taken. Labat has frequently taken them with nets, properly extended round the places they breed in. When their long legs are entangled in the meshes, they are then unqualified to make their escape: but they still continue to combat with their destroyer; and the old ones, though seized by the head, will scratch with their claws; and these, though seemingly inoffensive, very often do mischief. When they are fairly disengaged from the net, they nevertheless preserve their natural ferocity: they refuse all nourishment; they peck, and combat with their claws, at every opportunity. The fowler is, therefore, under a necessity of destroying them, when taken; as they would only pine and die, if left to themselves in captivity.

The flesh of the old ones is black and hard; though, Dampier says, well tasted: that of the young ones is still better. But of all other delicacies, the flamingo's tongue is the most celebrated. "A dish of flamingos' tongues," says our author, "is a feast for an emperor." In fact, the Roman emperors considered them as the highest luxury; and we have an account of one of them, who procured fifteen hundred flamingos' tongues to be served up in a single dish. The tongue of this bird, which is so much sought after, is a good deal larger than that of any other bird whatever. The bill of the flamingo is like a large black box, of an irregular figure, and filled with a tongue which is black and gristly; but what peculiar flavour it may possess, I leave to be determined by such as understand good eating better than I do. It is probable, that the beauty and scarcity of the bird might be the first inducements to studious gluttony to fix upon its tongue as meat for the table. What Dampier says of the goodness of its flesh, cannot so well be relied on; for Dampier was often hungry, and thought any thing good that could be eaten: he avers, indeed, with Labat, that the flesh is black, tough, and fishy; so that we can hardly give him credit, when he asserts, that its flesh can be formed into a luxurious entertainment.

These birds, as was said, always go in flocks together; and they move in rank, in the manner of cranes. They are sometimes seen, at the break of day, flying down in great numbers from the mountains, and conducting each other with a trumpet cry, that sounds like the word *Tococo*, from whence the savages of Canada have given them the name. In their flight, they appear to great advantage; for they then seem of as bright a red as a

burning coal. When they dispose themselves to feed, their cry ceases; and then they disperse over a whole marsh, in silence and assiduity. Their manner of feeding is very singular: the bird thrusts down its head, so that the upper convex side of the bill shall only touch the ground; and in this position the animal appears, as it were, standing upon its head. In this manner it paddles and moves the bill about, and seizes whatever fish or insect happens to offer. For this purpose the upper chap is notched at the edges, so as to hold its prey with the greater security. Catesby, however, gives a different account of their feeding. According to him, they thus place the upper chap undermost, and so work about, in order to pick up a seed from the bottom of the water, that resembles millet: but as in picking up this they necessarily also suck in a great quantity of mud, their bill is toothed at the edges in such a manner as to let out the mud while they swallow the grain.

Their time of breeding is according to the climate in which they reside: in North America they breed in our summer; on the other side of the line, they take the most favourable season of the year. They build their nests in extensive marshes, and where they are in no danger of a surprise. The nest is not less curious than the animal that builds it: it is raised from the surface of the pool about a foot and a half, formed of mud scraped up together, and hardened by the sun, or the heat of the bird's body; it resembles a truncated cone, or one of the pots which we see placed in chimneys; on the top it is hollowed out to the shape of the bird, and in that cavity the female lays her eggs without any lining but the well-cemented mud that forms the sides of the building. She always lays two eggs, and no more; and, as her legs are immoderately long, she straddles on the nest, while her legs hang down, one on each side, into the water.

The young ones are a long while before they are able to fly; but they run with amazing swiftness. They are sometimes caught; and, very different from the old ones, suffer themselves to be carried home, and are tamed very easily. In five or six days they become familiar, eat out of the hand, and drink a surprising quantity of sea-water. But though they are easily rendered domestic, they are not reared without the greatest difficulty; for they generally pine away, for want of their natural supplies, and die in a short time. While they are yet young, their colours are very different from those lively tints they acquire with age. In their first year they are covered with plumage of a white colour, mixed with gray: in the second year the whole body is white, with here and there a slight tint of scarlet; and the great covert feathers of his wings are black; the third year the bird acquires all its beauty; the plumage of the whole body is scarlet, except some of the feathers in the wings, that still retain their sable hue. Of these beautiful plumes the savages make various ornaments; and the bird is sometimes skinned by the Europeans, to make muffs. But these have diminished in their price, since we have obtained the art of dying feathers of the brightest scarlet.

CHAP. IX.

THE AVOSETTA, OR SCOOPER; AND THE CORRIRA, OR RUNNER.



The extraordinary shape of the Avosetta's bill might incline us to wish for its history; and yet in that we are not able to indulge the reader. Natural historians have hitherto, like ambitious monarchs, shown a greater fondness for extending their dominions, than cultivating what they possess. While they have been labouring to add new varieties to their catalogues, they have neglected to study the history of animals already known.

The avosetta is chiefly found in Italy, and now and then comes over into England. It is about the size of a pigeon, is a pretty upright bird, and has extremely long legs for its size. But the most extraordinary part of its figure, and that by which it may be distinguished from all others of the feathered tribe, is the bill, which turns up like a hook, in an opposite direction to that of the hawk or the parrot. This extraordinary bill is black, flat, sharp, and flexible at the end, and about three inches and a half long. From its being bare a long way above the knee, it appears that it lives and wades in the waters. It has a chirping pert note, as we are told; but with its other habits we are entirely unacquainted. I have placed it, from its slender figure, among the cranes; although it is web-footed, like the duck. It is one of those birds of whose history we are yet in expectation.[1]

[1] The Avosets of Europe and America prefer cold and temperate climates to hot countries. Their migrations

To this bird of the crane kind, so little known, I will add another, still less known; the Corrira, or runner, of Aldrovandus. All we are told of it is, that it has the longest legs of all web-footed fowls, except the flamingo and avosetta; that the bill is straight, yellow, and black at the ends; that the pupils of the eyes are surrounded with two circles, one of which is bay, and the other white; below, near the belly, it is whitish; the tail, with two white feathers, black at the extremities; and that the upper part of the body is of the colour of rusty iron. It is thus that we are obliged to substitute dry description for instructive history; and employ words to express those shadings of colour which the pencil alone can convey.

CHAP. X.

SMALL BIRDS OF THE CRANE KIND, WITH THE THIGHS PARTLY BARE OF FEATHERS.

As I have taken my distinctions rather from the general form and manners of birds, than from their minuter though perhaps more precise discriminations, it will not be expected that I should here enter into a particular history of a numerous tribe of birds, whose manners and forms are so much alike. Of many of them we have scarcely any account in our historians, but tedious descriptions of their dimensions, and the colour of their plumage; and of the rest, the history of one is so much that of all, that it is but the same account repeated to a most disgusting reiteration. I will therefore group them into one general draught; in which the more eminent, or the most whimsical, will naturally stand forward on the canvass.

In this tribe we find an extensive tribe of native birds, with their varieties and affinities; and we might add a hundred others, of distant climates, of which we know little more than the colour and the name. In this list is exhibited the Curlew, a bird of about the size of a duck, with a bill four inches long: the Woodcock, about the size of a pigeon, with a bill three inches long: the Godwit, of the same size; the bill four inches: the Green Shank, longer legged; the bill two inches and a half: the Red Shank, differing in the colour of its feet from the former: the Snipe, less by half, with a bill three inches. Then with shorter bills—The Ruff, with a collar of feathers round the neck of the male: the Knot, the Sandpiper, the Sanderling, the Dunlin, the Purre, and the Stint. To conclude: with bills very short—The Lapwing, the Green Plover, the Gray Plover, the Dottrel, the Turnstone, and the Sea-lark. These, with their affinities, are properly natives or visitants of this country; and are dispersed along our shores, rivers, and watery grounds. Taking in the birds of this kind, belonging to other countries, the list would be very widely extended; and the whole of this class, as described by Brisson, would amount to near a hundred.[1]

All these birds possess many marks in common; though some have peculiarities that

are determined by the want or abundance of food. In winter they assemble in small flocks of six or seven, and frequent our shores, especially the mouths of large muddy rivers, in search of worms and marine insects. These they scoop out of the mud with their recurved bills, which are admirably adapted for that purpose, being tough and flexible like whalebone. The feet seem calculated for swimming, but they are never observed to take the water: it is therefore probable, that they are furnished with a web merely to prevent their sinking into the mud. The female lays two eggs, about the size of those of a pigeon, of a white colour tinged with green, and marked with large black spots. It is said to be very tenacious of its young, and when disturbed at this season, will fly round in repeated circles, uttering a note that resembles the word *twit-twit*.

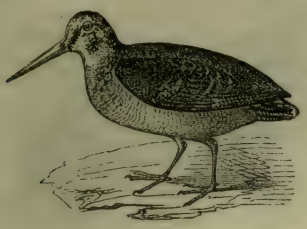
[1] The *Curlew*.—There are two species of the curlew to be found in Europe—the *Common Curlew* and the



Little Curlew, but there are various other species, in Asia, Africa, and America, differing very much in size, the longest measuring about twenty-five inches, and sometimes weighing thirty-six ounces. These birds fly in considerable flocks, and are well known upon the sea-coasts in moist parts, where, and in the marshes, they frequent in winter. They feed on worms, frogs, and all kinds of marine insects. In April, or the beginning of May, they retire into mountainous and unfrequented parts on the sea-shore, where they breed; and do not return again till the approach of winter. There have been some advocates in favour of the flesh of this bird, but in general it is strong and fishy. It has a long black bill, much curved or arched, about eight fingers long, and beginning to bend a little downwards about three fingers from the head. The middle parts of the feathers on the head, neck, and back, are black; the borders or outsides ash-coloured, with an intermixture of red; and those between the wings and back are of a most beautiful glossy blue, and shine like silk. The vent and belly are white. The feet are divided, but joined by a little membrane at the root. The tongue is very short, considering the length of the bill, and bears some resemblance to an arrow. The female is somewhat larger than the male, which is commonly called the jack-curlew; and the spots with which her body is covered almost over, is more inclining to a red.

deserve regard. All these birds are bare of feathers above the knee, or above the heel, as some naturalists choose to express it. In fact, that part which I call the knee, if compared with the legs of mankind, is analogous to the heel; but as it is commonly conceived otherwise, I have conformed to the general apprehension. I say, therefore, that all these

The *Woodcock*.—During the summer time the woodcock is an inhabitant of Norway, Sweden, Lapland, and



other northern countries, where it breeds. As soon, however, as the frosts commence, it retires southward to milder climates. These birds arrive in Great Britain in flocks; some of them in October, but not in great numbers till November and December. They generally take advantage of the night, being seldom seen to come before sun-set. The time of their arrival depends considerably on the prevailing winds; for adverse gales always detain them, they not being able to struggle with the boisterous squalls of the Northern ocean. After their arrival in bad weather, they have often been seen so much exhausted as to allow themselves to be taken by the hand, when they alighted near the coast. They live on worms and insects, which they search for with their long bills in soft ground and moist woods, feeding and flying principally in the night. They go out in the evening; and generally return in the same direction, through the same glades, to their day-retreat. The greater part of them leave this country about the latter end of February, or the beginning of March, always pairing before they set out. They retire to the coast, and, if the wind be fair, set out immediately; but if contrary, they are often detained in the neighbouring woods and thickets for some time. In this crisis the sportsmen are all on the alert, and the whole surrounding country echoes to the discharge of guns; seventeen brace have been killed by one person in a day. But if they are detained long on the dry heaths, they become so lean as to be scarcely eatable. The instant a fair wind springs up, they seize the opportunity; and where the sportsman has seen hundreds in one day, he will not find even a single bird the next. Very few of them breed in England; and perhaps with respect to those that do, it may be owing to their having been wounded by the sportsman in the winter, so as to be disabled from taking their long journey in the spring. They build their nests on the ground, generally at the root of some tree, and lay four or five eggs about the size of those of a pigeon, of a rusty colour, and marked with brown spots. They are remarkably tame during incubation. A person who discovered a woodcock on its nest, often stood over, and even stroked it; notwithstanding it hatched the young ones, and in due time, disappeared with them.

The *Snipes*, though agreeing very much in external resemblance with the woodcocks, differ from them in natural habits. They do not inhabit woods, but remain in the marshy parts of meadows, in the herbage, and amongst the osiers which are on the banks of rivers. They are still more generally spread than the woodcocks, and there are no portions of the globe in which some of them have not been found. They are observed to be incessantly employed in picking the ground, and Aldrovandus has remarked that they have the tongue terminating in a sharp point, proper for piercing the small worms, which, probably, constitute their food; for though nothing is found in their stomachs but liquid, and an earthy sediment, it must be that such soft bodies as worms, &c. dissolve there very quickly, and that the earth which enters along with them, is the only substance unsusceptible of liquefaction. Autumn is the season for the arrival of the common snipe in most of the southern and western countries of Europe. It then extends through meadows, marshes, bogs, and along the banks of streams and rivers. When it walks, it carries the head erect, without either hopping or fluttering, and gives it a horizontal movement, while the tail moves up and down. When it takes flight, it rises so high as often to be heard after it is lost sight of. Its cry has been sometimes likened to that of the she-goat. The snipes for the most part, migrating northwards, in the spring, nestle in Germany, Switzerland, Silesia, &c. Some, however, continue in their more southern stations, making their nest in the month of June, under the root of some alder or willow, in a sheltered place. This nest is composed of dry plants and feathers, and the female lays four or five oblong eggs, of a whitish tint, spotted with red. If the female be disturbed during incubation, she rises very high, and in a right line, then utters a particular cry, and re-descends with great rapidity. While the female is hatching, the male is frequently observed to hover around her, uttering a kind of hissing noise. The young quit the nest on issuing from the shell, and then appear very ugly and deformed. Until their bill grows firm, the mother continues her care of them, and does not leave them until they can do without her. The snipe usually grows very fat, both in Europe and North America; but much less so in warm climates. Its flesh, after the early frosts, acquires a fine and delicate flavour. It is cooked, as well as the woodcock, without being drawn, and is in universal estimation as an exquisite game. It is caught in various ways, and is well known to be a difficult shot, when turned and winding in the air; though by no means so when suffered to proceed in a right line, especially as the smallest grain of lead is sufficient to bring it down, and the slightest touch will make it fall.

The *Double Snipe* was considered by Buffon as a mere variety of the common, as that naturalist probably took into consideration only its superior size, and the trifling difference of the plumage. It has, however, since his time, been ascertained to be a different species. It differs from the common snipe in its cry, in its flight, which is generally direct, and with few or no circlings, and in its habits, preferring to marshy and muddy grounds, those places where there is but little water, and where it is clear. There is little else worth remarking concerning it.

The *Little Snipe* is not larger than a lark. It is less generally extended than the common species. In France, it remains in the marshes almost during the whole year, where it nestles and lays eggs, like those of the common snipe. Concealed in reeds and rushes, it remains there so pertinaciously that it is necessary almost to walk upon it to make it rise. Its flight is less rapid and more direct than that of the common snipe. Its fat is equally fine, and its flesh similarly well-flavoured. It is not very common in this country. For *Variegated Snipe*, see Plate XIX. fig. 18.; for *Wilson's Snipe*, see fig. 19.

There is a number of other species of woodcock and snipe, but there is nothing in their habits to induce us to exceed the limits to which we are necessarily pre-

birds are bare of feathers above the knee ; and in some they are wanting half way up the thigh. The nudity in that part, is partly natural, and partly produced by all birds of this kind habitually wading in water. The older the bird, the barer are its thighs; yet even the young ones have not the same downy covering reaching so low as the birds of any

scribed in this portion of our work. The following cut represents the *Common Snipe*.



The *Godwits* are to be distinguished from the foregoing. The woodcocks, properly so called, inhabit woods. The snipes live in fresh water marshes; but the godwits prefer the sea-shore. The passage of the last into the temperate climates of Europe takes place in September, and, for their short stay, they frequent salt marshes, where like the snipes, &c. they live on small worms, which they draw out of the mud. Those which are sometimes to be met with in island places, have doubtless been driven there by the wind. Mauduyt, who observed some of them exposed for sale in the Parisian markets, in spring, concluded, and justly, that they make a second passage in spring, and not that they ever nestle on the French coasts. These timid birds, whose sight moreover is weak, remain in the shade during the day-time, and it is only by evening twilight, or early dawn, that they proceed in search of food, for the discrimination of which their bill is particularly fitted. Little stones are sometimes found in their gizzard, but we cannot conclude that these hard substances answer with them, as with the gallinæ, for the trituration of their food, which is too soft to require any thing of the kind, but rather that they have been taken in along with it. These birds are particularly wild, and fly precipitately from the slightest appearance of danger, uttering a cry which Belon compares to the smothered bleating of a she-goat. At the time of their arrival they are seen in flocks, and often heard, passing very high, in the evening or by moonlight. But the moment they alight, they are so much fatigued that they resume their flight with much difficulty ; at such times, though they run with swiftness, they can be easily turned, and sufficient numbers driven together to enable the fowler to kill several of them with a single shot. They remain but a short time at one place, and it is not uncommon to find them no longer in the morning, in those marshes, where, the preceding evening, they had been extremely numerous. For marbled Godwit, see Plate XX. fig. 17.

The *Sanderlings* are found in Europe, in Asia, in North America, and in New South Wales. They inhabit the sea-shores, and abound, in spring and autumn, both on the coasts of Holland and of this country. They are only seen accidentally in countries remote from the sea. There is but one species ; but as these birds, which undergo two moultings, are most frequently seen in their summer plumage, in which red, or reddish, is the predominant colour, while in the winter it is gray, it is not wonderful that naturalists have made a distinct species under the title of *Charadrius Rubidus*. The sanderlings traverse in their periodical migrations a large portion of the globe. But they are only seen accidentally along rivers, which leads to the presumption that their aliment consists of small marine worms and insects. They breed in the North. The following cut represents a *Common Sanderling*.



The *Sea Larks*, a name exceedingly improper, as tending to the confusion of two genera so widely remote, never quit the edge of waters, and especially prefer the sea-shore, although they occasionally remove to a considerable distance from it, since they are frequently seen around the lakes and along the rivers of the Vosges and the Pyrenees. They are birds of passage, at least in many countries of Europe. They proceed very far to the north; for they are found in Sweden, on the borders of the Caspian sea, and throughout the whole of Siberia. During winter they are very common both in France and England. The species is named by Latham, *Purre Sandpiper*. Except during the nestling time, these birds unite in flocks, often so crowded, that a great number of them may be killed by a single shot. Nothing, says Belon, is more wonderful concerning this little bird, than to see five or six hundred dozens of them brought, on a single Saturday, in winter, to the Paris market. They constitute an excellent game, but must be eaten fresh ; they are not, however, destitute of that oily taste which appertains to almost all species of aquatic birds.

The *Plovers* habitually frequent the sea-coast, the mouths of rivers, and salt marshes. They feed upon crustacea, and small molluscous animals, which they catch in the sand along the line of waters, over which they are seen continually flying, uttering a little cry. Many species live solitarily, or in couples; some others in small flocks. These birds are to be found in almost all the countries of the globe, from the equator to the coldest latitudes of the northern and southern hemispheres. They are all clad in sombre colours, the distribution of which is, however, not unpleasing. Most of them undergo a double moulting, and are vested in various liveries, according to age and sex. Some species have spines, which serve as defensive weapons, attached to their wings; some others have fleshy appendages at the base of the bill. The plovers emigrate every year, in flocks of greater or less numbers, and this principally takes place in autumn, during the rainy season, whence their French name (*pluviers*) is derived, and of which our word plover is an obvious corruption. At this time they are seen in the greatest abundance. They do not remain quiet when on the ground, but are seen in incessant motion. They fly in an extended file, or in transverse zones, very narrow and of a great length. Their flesh is delicate and much esteemed. They are frequently taken, in great quantities, in the countries where they are common, by means of nets variously fabricated.

Of these, the first and most common is the *Golden Plover*. This bird frequents humid and marshy grounds. In winter it is very common on the coasts of France and Holland. It is found in England during the entire

other class. Such a covering there would rather be prejudicial, as being continually liable to get wet in the water.

As these birds are usually employed rather in running than in flying, and as their food lies entirely upon the ground, and not on trees or in the air, so they run with great swiftness for their size, and the length of their legs

year; it is also very abundant in the Highlands of Scotland, in the Western islands, and in the Isle of Man.



It is again found in America, in Asia, and in the islands of the South sea. Throughout the north of Europe it is common, and in all parts of Germany, Italy, and Spain. From the latter country we trace it into Barbary, and other parts of Africa; and it is to be found as far to the south-east of Asia, as India, China, and the Archipelago of the Eastern ocean. These birds lay from three to five eggs, of rather an olive-green colour, with black spots. They live on worms, insects, and larvæ. There is very little difference in appearance between the male and female. These plovers strike the earth with their feet to cause the worms, &c., to issue from their retreat. In the morning, like the lapwings and the snipes, they visit the water side to wash their bills and feet. They are rarely seen longer than twenty-four hours in the same place, which doubtless proceeds from their numbers, which cause a rapid exhaustion of their means of subsistence in any given spot. They migrate from the districts which they inhabit when the snow falls and the frost begins to be intense, as their resources of provision are then cut off, and they are deprived of the water, which their constitution renders indispensable to them. It is very rare to see a golden plover alone, and Belon tells us that the smallest flocks in which they fly amount at least to fifty each. When they are seeking their food, several of them act as sentinels, and on the appearance of any danger, set up a shrill cry, as a warning to the others, and a signal for flight. These flocks disperse in the evening, and each individual passes the night apart; but at the dawn of day, the first that awakes gives a cry of appeal to the rest, which immediately re-assemble on this call. This cry is imitated by the fowlers to draw these birds into their nets. The flesh of these plovers is in high estimation, in general, though the peculiarity of its flavour does not equally please every palate. It is best when the birds are rather fat than otherwise.

The *Dotterel Plover*.—The length of this bird is about nine inches. Its bill is black; the cheeks and throat are white; the back and wings are of a light brown, inclining to olive; the breast is of a dull orange: the belly, thighs and vent are of a reddish white; the tail is of an olive brown, and tipped with white; the legs are of a dark olive colour. The dotterel is common in various parts of Great Britain, though in some places it is scarcely known. They are supposed to breed in the mountains of Cumberland and Westmoreland, where they are sometimes seen in the month of May, during the breeding season; they likewise breed on several of the Highland hills. They are very common in Cambridgeshire, Lincolnshire, and Derbyshire, appearing in small flocks on the heaths and moors of these counties during the months of May and June; and are then very fat, and much esteemed for the table. This bird is remarkable for its stupidity.

The *Redshank*.—This bird weighs about five ounces and a half; its length is twelve inches, and the breadth twenty-one. The bill, from the tip to the corners of the mouth, is more than an inch and three quarters long, black at the point, and red towards the base: the feathers on the crown of the head are dark brown, edged with pale rufous; a light or whitish line passes over, and encircles each eye, from the corners of which a dark brown spot is extended to the beak: irides hazel: the hinder part of the neck is obscurely spotted with dark brown, or a rusty ash-coloured ground; the throat and fore-part are more distinctly marked in streaks of the same colour: on the breast and belly, which are white, tinged with ash, the spots are thinly distributed, and are shaped something like the heads of arrows or darts.

The *Spotted Redshank*.—The length of this bird, from the tip of the bill to the end of the tail, is twelve inches, and to the end of the toes fourteen inches and a half; its breadth twenty-one inches and a quarter; and its weight above five ounces avoirdupois. The bill is slender, measured two inches and a half from the corners of the mouth to the tip, and is, for half its length nearest the base, red; the other part black: irides hazel; the head, neck, breast, and belly, are spotted in streaks, mottled and barred with dingy ash brown and dull white, darker on the crown and hinder part of the neck; the throat is white; and lines of the same colour pass from the upper sides of the beak over each eye, from the corners of which two brown ones are extended to the nostrils. The ground colour of the shoulders, scapulars, lesser coverts, and tail, is a glossy olive brown; the feathers on all these parts are indented on the edges, more or less, with triangular-shaped white spots. The back is white; the rump barred with wave lines of ash-coloured brown, and dingy white; the vent feathers are marked nearly in the same manner, but with a greater portion of white: the tail and coverts are also barred with narrow waved lines of a dull ash-colour, and, in some specimens, are nearly black and white. Five of the primary quills are dark brown, tinged with olive; the shaft of the first quill is white; the next six are, in the male, rather deeply tipped with white, and slightly spotted and barred with brown: the secondaries, as far as they are unconverted when the wings are extended, are of the same snowy whiteness as the back. The feathers which cover the upper part of the thighs, and those near them, are blushed with a reddish or vinous colour: the legs are of a deep orange red, and measure, from the end of the middle toe-nail to the upper bare part of the thigh, five inches and a half.

The *Green Sandpiper*.—This bird measures about ten inches in length, to the end of the toes nearly twelve, and weighs about three ounces and a half. The bill is black, and an inch and a half long: a pale streak extends from it over each eye; between which, and the corners of the mouth, there is a dusky patch. The crown of the head, and the hinder part of the neck, are of a dingy, brownish ash-colour; in some specimens narrowly streaked with white. The throat is white; fore-part of the neck mottled or streaked with brown spots on a white or pale ash-coloured ground. The whole upper part of the plumage is of a glossy bronze,

assists their velocity. But, as in seeking their food, they are often obliged to change their station; so also are they equally swift of wing, and traverse immense tracts of country without much fatigue.

It has been thought by some, that a part of this class lived upon an oily slime, found in the bottoms of ditches and of weedy pools; they were thence termed, by Willoughby, *Mudsuckers*. But later discoveries have shown that, in these places, they hunt for the caterpillars and worms of insects. From hence, therefore, we may generally assert, that all birds of this class live upon animals of one kind or another. The long-billed birds suck up worms and insects from the bottom; those furnished with shorter bills, pick up such insects as lie nearer the surface of the meadow, or among the sands on the sea-shore.

Thus the curlew, the woodcock, and the snipe, are ever seen in plashy brakes, and under covered hedges, assiduously employed in seeking out insects in their worm state; and it seems, from their fatness, that they find a plentiful supply. Nature, indeed, has furnished them with very convenient instruments for procuring their food. Their bills are made sufficiently long for searching; but still more they are endowed with an exquisite sensibility at the point, for feeling their provision. They are furnished with no less than three pair of nerves, equal almost to the optic nerves in thickness; which pass from the roof of the mouth, and run along the upper chap to the point.

Nor are those birds with shorter bills, and destitute of such convenient instruments, without a proper provision made for their subsistence. The lapwing, the sandpiper, and the redshank, run with surprising rapidity along the surface of the marsh or the sea-shore, quarter their ground with great dexterity, and leave nothing of the insect kind that happens to lie on the surface. These, however, are neither so fat nor so delicate as the former; as they are obliged to toil more for a subsis-

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or olive brown, elegant marked on the edge of each feather with small roundish white spots: the quills are without spots, and are of a darker brown: the secondaries and tertials are very long: the insides of the wings are dusky, edged with white gray; and the inside coverts next the body are curiously barred, from the shaft of each feather to the edge, with narrow white lines, formed nearly of the shape of two sides of a triangle. The belly, vent, tail coverts, and tail, are white; the last broadly barred with black, the middle feathers having four bars, and those next to them decreasing in the number of bars towards the outside feathers, which are quite plain: the legs are green.

The *Dunlin* (see Plate XIX. fig. 14.) This is the size of a jack snipe. The upper parts of the plumage are ferruginous, marked with large spots of black and a little white; the lower parts are white, with dusky streaks. It is found in all the northern parts of Europe.

The *Lapwing* or *Peewit*.—This bird is about the size of a common pigeon, and is covered with very thick plumes, which are black at the roots, but of a different colour on the outward part. The feathers on the belly, thighs, and under the wings, are most of them white as snow; and the under part on the outside of the wings white, but black lower. It has a great liver divided into two parts; and, as some authors affirm, no gall. Lapwings are found in most parts of Europe, as far northward as Iceland. In the winter they are met with in Persia, and Egypt. Their chief food is worms; and sometimes they may be seen in flocks nearly covering the low marshy grounds in search of these, which they draw with great dexterity from their holes. When the bird meets with one of these little clusters of pellets, or rolls of earth that are thrown out by the worm's perforations, it first gently removes the mud from the mouth of the hole, then strikes the ground at the side with its foot, and steadily and attentively waits the issue; the reptile, alarmed by the shock, emerges from its retreat, and is instantly seized. These birds make a great noise with their wings when flying; and are called pee-wits, in Scotland and the north of England, from their particular cry. In other parts of the island, they are called green plovers. They remain here the whole year. The female lays two eggs on the dry ground, near some marsh, upon a little bed which it prepares of dry grass. She sits about three weeks; and the young, are able to run two or three days after they are hatched. The following cut represents a crested or *Green Lapwing*.



The *Turnstone*—Is about the size of a thrush; the bill is nearly an inch long, and turns a little upwards. The head, throat, and belly, are white: the breast black; and the neck encircled with a black colour. The upper parts of the plumage are of a pale reddish brown. These birds take their name from their method of finding their food, which is by turning up small stones with their bills to get the insects that lurk under them.

The *Whimbrel* (see Plate XIX. fig. 13.) The whimbrel is only about half the size of the curlew, which it very nearly resembles in shape, the colours of its plumage, and manner of its living. It is about seventeen inches in length, and twenty-nine in breadth; and weighs about fourteen ounces. The bill is about three inches long; the upper mandible black, the under one pale red. The upper part of the head is black, divided in the middle of the crown by a white line from the brown to the hinder part; between the bill and the eyes there is a darkish oblong spot; the sides of the head, the neck, and breast, are of a pale brown, marked with narrow dark streaks pointing downwards; the belly is of the same colour, but the dark streaks upon it are larger; about the vent it is quite white; the lower part of the back is also white. The rump and tail feathers are barred with black and white; the shafts of the quills are white, the outer webs totally black, but the inner ones marked with large white spots: the secondary quills are spotted in the same manner on both the inner and outer webs. The legs and feet are of the same shape and colour as those of the curlew.

tence, they are easily satisfied with whatever offers; and their flesh often contracts a relish of what has been their latest, or their principal food.

Most of the birds formerly described, have stated seasons for feeding and rest: the eagle kind prowl by day, and at evening repose; the owl by night, and keeps unseen in the day-time: but these birds, of the crane kind, seem at all hours employed; they are seldom at rest by day; and, during the whole night-season, every meadow and marsh resounds with their different calls, to courtship or to food.

This seems to be the time when they least fear interruption from man; and though they fly at all times, yet at this season, they appear more assiduously employed, both in providing for their present support, and continuing that of posterity. This is usually the season when the insidious fowler steals in upon their occupations, and fills the whole meadow with terror and destruction.

As all of this kind live entirely in waters, and among watery places, they seem provided by nature with a warmth of constitution to fit them for that cold element. They reside, by choice, in the coldest climates: and as other birds migrate here in our summer, their migrations hither are mostly in the winter. Even those that reside among us the whole season, retire in summer to the tops of our bleakest mountains: where they breed, and bring down their young, when the cold weather sets in.

Most of them, however, migrate, and retire to the polar regions; as those that remain behind in the mountains, and keep with us during summer, bear no proportion to the quantity which in winter haunt our marshes and low grounds. The snipe sometimes builds here; and the nest of the curlew is sometimes found in the plashes of our hills; but the number of these is very small; and it is most probable that they are only some stragglers who, not having strength or courage sufficient for the general voyage, take up from necessity their habitation here.

In general, during the summer, this whole class either choose the coldest countries to retire to, or the coldest and the moistest part of ours to breed in. The curlew, the woodcock, the snipe, the godwit, the gray plover, the green and the long-legged plover, the knot, and the turnstone, are rather the guests than the natives of this island. They visit us in the beginning of winter, and forsake us in the spring. They then retire to the mountains of Sweden, Poland, Prussia, and Lapland, to breed. Our country, during the summer season, becomes uninhabitable to them. The ground parched up by the heat; the springs dried away; and the vermicular insects already upon the wing; they have no means of subsisting. Their weak and delicately pointed bills are unfit to dig into a resisting soil; and their prey is departed, though they were able to reach its retreats. Thus, that season when nature is said to teem with life, and to put on her gayest liveries, is to them an interval of sterility and famine. The coldest mountains of the north are then a preferable habitation; the marshes there are never totally dried up; and the insects are in such abundance, that both above ground and underneath, the country swarms with them. In such retreats, therefore, these birds would continue always; but that the frosts, when they set in, have the same effect upon the face of the landscape, as the heats of summer. Every brook is stiffened into ice; all the earth is congealed into one solid mass; and the birds are obliged to forsake a region where they can no longer find subsistence.

Such are our visitants. With regard to those which keep with us continually, and breed here, they are neither so delicate in their food, nor perhaps so warm in their constitutions. The lapwing, the ruff, the redshank, the sand-piper, the seapie, the Norfolk plover, and the sea-lark, breed in this country, and for the most part reside here. In summer they frequent such marshes as are not dried up in any part of the year; the Essex hundreds, and the fens of Lincolnshire. There, in solitudes formed by surrounding marshes, they breed and bring up their young. In winter they come down from their retreats, rendered uninhabitable by the flooding of the waters, and seek their food about our ditches and marshy meadow-grounds. Yet even of this class, all are wanderers upon some occasions; and take wing to the northern climates, to breed and find subsistence. This happens when our summers are peculiarly dry; and when the fenny countries are not sufficiently watered to defend their retreats.

But though this be the usual course of nature, with respect to these birds, they often break through the general habits of their kind; and as the lapwing, the ruff, and the sand-piper, are sometimes seen to alter their manners, and to migrate from hence, instead of continuing to breed here; so we often find the wood-cock, the snipe, and the curlew, reside with us during the whole season, and breed their young in different parts of the country. In Casewood, about two miles from Tunbridge, as Mr Pennant assures us, some woodcocks are seen to breed annually. The young have been shot there in the beginning of August; and were as healthy and vigorous as they are with us in winter, though not so well

tasted. On the Alps, and other high mountains, says Willoughby, the woodcock continues all summer; I myself have flushed them on the top of Mount Jura, in June and July. The eggs are long, of a pale red colour, and stained with deeper spots and clouds. The nests of the curlew and the snipe are frequently found; and some of these perhaps never entirely leave this island.

It is thus that the same habits are, in some measure, common to all; but in nestling, and bringing up their young, one method takes place universally. As they all run and feed upon the ground, so they are all found to nestle there. The number of eggs generally to be seen in every nest, is from two to four; never under, and very seldom exceeding. The nest is made without any art; but the eggs are either laid in some little depression of the earth, or on a few bents and long grass, that scarcely preserve them from the moisture below. Yet such is the heat of the body of these birds, that the time of incubation is shorter than with any other of the same size. The magpie, for instance, takes twenty-one days to hatch its young; the lapwing takes but fourteen. Whether the animal oil, with which these birds abound, gives them this superior warmth, I cannot tell; but there is no doubt of their quick incubation.

In their seasons of courtship, they pair as other birds; but not without violent contests between the males, for the choice of the female. The lapwing and the plover are often seen to fight among themselves; but there is one little bird of this tribe, called the *Ruff*, that has got



the epithet of the *fighter*, merely from its great perseverance and animosity on these occasions. In the beginning of spring, when these birds arrive among our marshes, they are observed to engage with desperate fury against each other: it is then that the fowlers, seeing them intent on mutual destruction, spread their nets over them, and take them in great numbers. Yet even in captivity their animosity still continues: the people that fatten them up for sale, are obliged to shut them up in close dark rooms; for if they let ever so little light in among them, the turbulent prisoners instantly fall to fighting with each other, and never cease till each has killed its antagonist, especially, says Willoughby, if any body stands by. A similar animosity, though in a less degree, prompts all this tribe; but when they have paired, and begun to lay, their contentions are then over.

The place these birds chiefly choose to breed in, is in some island surrounded with sedgy moors, where men seldom resort; and in such situations I have often seen the ground so strewed with eggs and nests, that one could scarcely take a step, without treading upon some of them. As soon as a stranger intrudes upon these retreats, the whole colony is up, and a hundred different screams are heard from every quarter. The arts of the lapwing, to allure men or dogs from her nest, are perfectly amusing. When she perceives the enemy approaching, she never waits till they arrive at her nest, but boldly runs to meet them: when she has come as near them as she dares to venture, she then rises with a loud screaming before them, seeming as if she were just flushed from hatching; while she is then probably a hundred yards from the nest. Thus she flies with great clamour and anxiety, whining and screaming around the invaders, striking at them with her wings, and fluttering as if she were wounded. To add to the deceit, she appears still more clamorous, as more remote from the nest. If she sees them very near, she then seems to be quite unconcerned, and her cries cease, while her terrors are really augmenting. If there be dogs, she flies heavily at a little distance before them, as if maimed; still vociferous and still bold, but never offering to move towards the quarter where her treasure is deposited. The dog pursues, in hopes every moment of seizing the parent, and by this means actually loses the young; for the cunning bird, when she has thus drawn him off to a proper distance, then puts forth her powers, and leaves her astonished pursuers to gaze at the rapidity of her flight. The eggs of all these birds are highly valued by the luxurious; they are boiled hard, and thus served up without any further preparation.

As the young of this class are soon hatched, so, when excluded, they quickly arrive at maturity. They run about after the mother as soon as they leave the egg; and being covered with a thick down, want very little of that clutching which all birds of the poultry kind, that follow the mother, indispensably require. They come to their adult state long before winter; and then flock together till the breeding season returns, which for a while dissolves their society.

As the flesh of almost all these birds is in high estimation, so many methods have been contrived for taking them. That used in

taking the ruff, seems to be most advantageous; and it may not be amiss to describe it. The *Ruff*, which is the name of the male, the Reeve that of the female, is taken in nets about forty yards long, and seven or eight feet high. These birds are chiefly found in Lincolnshire and the Isle of Ely, where they come about the latter end of April, and disappear about Michaelmas. The male of this bird, which is known from all others of the kind by the great length of the feathers round his neck, is yet so various in his plumage, that it is said, no two ruffs were ever seen totally of the same colour. The nets in which these are taken, are supported by sticks, at an angle of near forty-five degrees, and placed either on dry ground, or in very shallow water, not remote from reeds: among these the fowler conceals himself, till the birds, enticed by a stale or stuffed bird, come under the nets; he then, by pulling a string, lets them fall, and they are taken; as are godwits, knots, and gray plovers, also in the same manner. When these birds are brought from under the net, they are not killed immediately, but fattened for the table, with bread and milk, hemp-seed and sometimes boiled wheat; but if expedition be wanted, sugar is added, which will make them a lump of fat in a fortnight's time. They are kept, as observed before, in a dark room; and judgment is required in taking the proper time for killing them, when they are at the highest pitch of fatness: for if that is neglected, the birds are apt to fall away. They are reckoned a very great delicacy; they sell for two shillings, or half-a-crown, a piece; and are served up to the table with the train, like woodcocks, where we will leave them.

CHAP. XI.

OF THE WATER-HEN, AND THE COOT.[1]

Before we enter upon water-fowls, properly so called, two or three birds claim our attention, which seem to form the shade between the web-footed tribe and those of the crane kind. These partake rather of the form than the habits of the crane; and though furnished with long legs and necks, rather swim than wade. They cannot properly be called web-footed; nor yet are they entirely destitute of membranes, which fringe their toes on each side, and adapt them for swimming. The birds in question are, the Water Hen and the Bald-Coot.

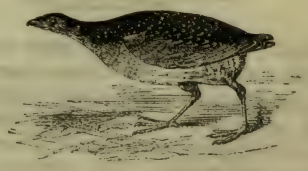
These birds have too near an affinity, not to be ranked in the same description. They are shaped entirely alike, their legs are long, and their thighs partly bare; their necks are proportionable, their wings short, their bills short and weak, their colour black, their foreheads bald and without feathers, and their habits entirely the same. These, however, naturalists have thought proper to range in different classes, from very slight distinctions in their figure. The water-hen weighs but fifteen ounces; the coot twenty-four. The bald part of the forehead in the coot is black; in the water-hen it is of a beautiful pink colour. The toes of the water-hen are edged with a straight membrane; those of the coot have it scolloped and broader.

The differences in the figure are but slight; and those in their manner of living still less. The history of the one will serve for both. As birds of the crane kind are furnished with long wings, and easily change place, the water-hen, whose wings are short,

[1] As bearing some affinity to this genus of birds, we may here notice the *Rails*, so called from the rattling sound of their cry. These birds, which remain during the day concealed in the grass, seek their food morning and evening in the reeds and plants of marshes and meadows. They fly very far, and walk with great agility. They never join in families and flocks. They raise their neck like hens when they are disturbed, and the young quit the nest immediately after birth, and seize of their own accord the food which is indicated to them by the mother. To the *Land-rail* or *Corn-crake*, these remarks are not perhaps applicable in all respects.

The *Water-rail* runs along stagnant waters as fast as the corn-crake does over the fields. Sometimes, instead of traversing the water by swimming, it sustains itself on the broad leaves of aquatic plants. Its food consists of insects, snails, and shrimps. It makes its nest in the midst of plants, by the side of ponds and streams, and the female lays from six to ten yellowish eggs, marked with spots of reddish-brown. The flesh of this bird has a marshy taste, but is, notwithstanding, in some estimation.

The *Land-rail*, or *Corn-crake*, is in the genus *Gallinule* of Latham. In the more southern countries this



is a bird of passage. It arrives among us and in France about April or May, and disappears in the commencement of October. By its short and sharp cry, *crik, crik*, we recognize its return. On approaching the quarter whence this cry proceeds, the sound is not discontinued, but heard a little farther on, which is occasioned by the bird, which can fly away but with difficulty, running with extreme swiftness through the tufted grass. In consequence of the coincidence between the return and departure of the quails and this bird, the latter has been sometimes deemed the conductor of the former. These birds are insectivorous when young, but the adult add grains, &c. of various kinds to this aliment.

is obliged to reside entirely near those places where her food lies: she cannot take those long journeys that most of the crane kind are seen to perform; compelled by her natural imperfections, as well perhaps as by inclination, she never leaves the side of the pond or the river in which she seeks for provision. Where the stream is selvaged with sedges, or the pond edged with shrubby trees, the water-hen is generally a resident there: she seeks her food along the grassy banks, and often along the surface of the water. With Shakspeare's Edgar, she drinks the green mantle of the standing pool; or, at least seems to prefer those places where it is seen. Whether she makes pond-weed her food, or hunts among it for water-insects, which are found there in great abundance, is not certain. I have seen them when pond-weed was taken out of their stomach. She builds her nest upon low trees and shrubs, of sticks and fibres, by the water-side. Her eggs are sharp at one end, white, with a tincture of green, spotted with red. She lays twice or thrice in a summer; her young ones swim the moment they leave the egg, pursue their parent, and imitate all her manners. She rears, in this manner, two or three broods in a season: and when the young are grown up, she drives them off to shift for themselves.

As the *Coot* is a larger bird, it is always seen in larger streams, and more remote from



mankind. The water-hen seems to prefer inhabited situations: she keeps near ponds, moats, and pools of water near gentlemen's houses; but the coot keeps in rivers, and among rushy margined lakes. It there makes a nest of such weeds as the stream supplies, and lays them among the reeds, floating on the surface, and rising and falling with the water. The reeds among which it is built keep it fast; so that it is seldom washed into the middle of the stream. But if this happens, which is sometimes the case, the bird sits in her nest, like a mariner in his boat, and steers with her legs her cargo into the nearest harbour: there, having attained her port, she continues to sit in great tranquillity, regardless of the impetuosity of the current; and though the water penetrates her nest, she hatches her eggs in that wet condition.

The water-hen never wanders; but the coot sometimes swims down the current, till it even reaches the sea. In this voyage these birds encounter a thousand dangers: as they cannot fly far, they are hunted by dogs and men; as they never leave the stream, they are attacked and destroyed by otters; they are preyed upon by kites and falcons; and they are taken in still greater numbers in weirs made for catching fish; for these birds are led into the nets, while pursuing small fish and insects, which are their principal food. Thus animated nature affords a picture of universal invasion! Man destroys the otter, the otter destroys the coot, the coot feeds upon fish, and fish are universally the tyrants of each other!

To these birds, with long legs and finny toes, I will add one species more, with short legs and finny toes; I mean the Grebe. The entire resemblance of this bird's appetites and manners to those of the web-footed class, might justly induce me to rank it among them; but as it resembles those above described, in the peculiar form of its toes, and bears some similitude in its manners also, I will for once sacrifice method to brevity. The grebe is much larger than either of the former, and its plumage white and black; it differs also entirely in the shortness of its legs, which are made for swimming, and not walking: in fact, they are from the knee upward hid in the belly of the bird, and have consequently very little motion. By this mark, and by the scolloped fringe of the toes, may this bird be easily distinguished from all other.

As they are thus, from the shortness of their wings, ill formed for flying, and from the uncommon shortness of their legs utterly unfitted for walking, they seldom leave the water, and chiefly frequent those broad shallow pools where their faculty of swimming can be turned to the greatest advantage, in fishing and seeking their prey.

They are chiefly, in this country, seen to frequent the meres of Shropshire and Cheshire; where they breed among reeds and flags, in a floating nest, kept steady by the weeds of the margin. The female is said to be a careful nurse of her young, being observed to feed them most assiduously with small eels; and when the little brood is tired, the mother will carry them either on her back or under her wings. This bird preys upon fish, and is always perpetually diving. It does not show much more than the head above water; and is very difficult to be shot, as it darts down on the appearance of the least

danger. It is never seen on land; and, though disturbed ever so often, will not leave that lake, where alone, by diving and swimming, it can find food and security. It is chiefly sought for the skin of its breast, the plumage of which is of a most beautiful silvery white, and as glossy as satin. This part is made into tippets; but the skins are out of season about February, losing their bright colour; and in breeding-time their breasts are entirely bare.

A

HISTORY OF BIRDS.

BOOK VII.

OF WATER-FOWL.

CHAP. I.

WATER-FOWL IN GENERAL.

In settling the distinctions among the other classes of birds, there was some difficulty; one tribe encroached so nearly upon the nature and habitudes of another, that it was not easy to draw the line which kept them asunder: but in water-fowl, nature has marked them for us by a variety of indelible characters; so that it would be almost as unlikely to mistake a land-fowl for one adapted for living and swimming among the waters, as a fish for a bird.

The first great distinction in this class appears in the toes, which are webbed together for swimming. Those who have remarked the feet or toes of a duck, will easily conceive how admirably they are formed for making way in the water. When men swim, they do not open the fingers, so as to let the fluid pass through them; but closing them together, present one broad surface to beat back the water, and thus push their bodies along. What man performs by art, nature has supplied to water-fowl; and, by broad skins, has webbed their toes together, so that they expand two broad oars to the water; and thus, moving them alternately, with the greatest ease paddle along. We must observe also, that the toes are so contrived, that as they strike backward, their broadest hollow surface beats the water; but as they gather them in again, for a second blow, their front surface contracts, and does not impede the bird's progressive motion.

As their toes are webbed in the most convenient manner, so are their legs also made most fitly for swift progression in the water. The legs of all are short, except the three birds described in a former chapter; namely, the flamingo, the avosetta, and the corrira: all which, for that reason, I have thought proper to rank among the crane kind, as they make little use of their toes in swimming. Except these, all web-footed birds have very short legs; and these strike, while they swim, with great facility.—Were the leg long, it would act like a lever whose prop is placed to a disadvantage; its motions would be slow, and the labour of moving it considerable. For this reason, the very few birds whose webbed feet are long, never make use of them in swimming: the web at the bottom seems only of service as a broad base, to prevent them from sinking while they walk in the mud; but it otherwise rather retards than advances their motion.

The shortness of their legs in the web-footed kinds, renders them as unfit for walking on land, as it qualifies them for swimming in their natural element. Their stay, therefore, upon land, is but short and transitory; and they seldom venture to breed far from the sides of those waters where they usually remain. In their breeding seasons, their young are brought up by the water-side; and they are covered with a warm down, to fit them for the coldness of their situation. The old ones, also, have a closer, warmer plumage, than birds of any other class. It is of their feathers that our beds are composed; as they neither mat, nor imbibe humidity, but are furnished with an animal-oil that glazes their surface, and keeps each other separate. In some, however, this animal-oil is in too great abundance, and is as offensive from its smell, as it is serviceable for the purposes of household economy. The feathers, therefore, of all the penguin kind are totally useless for domestic purposes; as neither boiling nor bleaching can divest them of their oily rancidity. Indeed, the rancidity of all new feathers, of

whatever water-fowl they be, is so disgusting, that our upholsterers give near double the price for old feathers that they afford for new: to be free from smell, they must all be lain upon for some time; and their usual method is to mix the new and the old together.

This quantity of oil, with which most water-fowl are supplied, contributes also to their warmth in the moist element where they reside. Their skin is generally lined with fat; so that, with the warmth of the feathers externally, and this natural lining more internally, they are better defended against the changes or the inclemencies of the weather, than any other class whatever.

As, among land-birds, there are some found fitted entirely for depredation, and others for a harmless method of subsisting upon vegetables, so also, among these birds, there are tribes of plunderers that prey, not only upon fish, but sometimes upon water-fowl themselves. There are likewise more inoffensive tribes, that live upon insects and vegetables only. Some water-fowls subsist by making sudden stoops from above, to seize whatever fish come near the surface; others again, not furnished with wings long enough to fit them for flight, take their prey by diving after it to the bottom.

From hence all water-fowl naturally fall into three distinctions. Those of the Gull kind, that, with long legs and round bills, fly along the surface to seize their prey: those of the Penguin kind, that, with round bills, legs hid in the abdomen, and short wings, dive after their prey: and, thirdly, those of the Goose kind, with flat broad bills, that lead harmless lives, and chiefly subsist upon insects and vegetables.

These are not speculative distinctions, made up for the arrangement of a system; but they are strongly and evidently marked by nature. The gull kind are active and rapacious; constantly, except when they breed, keeping upon the wing; fitted for a life of rapine, with sharp straight bills for piercing, or hooked at the end for holding their fishy prey. In this class we may rank the Albatross, the Cormorant, the Gannet or Solan Goose, the Shag, the Frigate-bird, the Great Brown Gull, and all the lesser tribe of gulls and sea-swallows.

The Penguin kind, with appetites as voracious, bills as sharp, and equally eager for prey, are yet unqualified to obtain it by flight. Their wings are short, and their bodies large and heavy, so that they can neither run nor fly. But they are formed for diving in a very peculiar manner. Their feet are placed so far backward, and their legs so hid in the abdomen, that the slightest stroke sends them head foremost to the bottom of the water. To this class we may refer the Penguin, the Auk, the Skout, the Sea-turtle, the Bottlenose, and the Loon.

The Goose kind are easily distinguishable, by their flat broad bills covered with a skin, and their manner of feeding, which is mostly upon vegetables. In this class we may place the Swan, the Goose, the Duck, the Teal, the Widgeon, and all their numerous varieties.

In describing the birds of these three classes, I will put the most remarkable of each class at the beginning of their respective tribes, and give their separate history; then, after having described the chiefs of the tribe, the more ordinary sorts will naturally fall in a body, and come under a general description, behind their leaders. But before I offer to pursue this methodical arrangement, I must give the history of a bird, that, from the singularity of its conformation, seems allied to no species; and should, therefore, be separately described—I mean the Pelican.

CHAP. II.

THE PELICAN.



The Pelican of Africa is much larger in the body than a swan, and somewhat of the same shape and colour. Its four toes are all webbed together; and its neck, in some measure, resembles that of a swan: but that singularity in which it differs from all other birds is in the bill and the great pouch underneath, which are wonderful, and demand a distinct description.[1] This enormous bill is fifteen

[1] The Pelican is one of the largest water-birds, considerably exceeding the size of the swan, and frequently measuring from five to six feet between the extremity of the bill and that of the tail, and from ten to twelve between the tips of the expanded wings. Its bill is nearly a foot and a half in length, and from an inch and a half to two inches broad; and its pouch is capable of containing, when stretched to its utmost extent, two or three gallons of water. The quantity of fish which it sometimes accumulates in the same serviceable repository is spoken of as enormous. Notwithstanding their great

inches from the point to the opening of the mouth, which is a good way back behind the eyes. At the base, the bill is somewhat greenish, but varies towards the end, being of a reddish-blue. It is very thick in the beginning, but tapers off to the end, where it hooks downwards. The under chap is still more extraordinary; for to the lower edges of it hangs a bag, reaching the whole length of the bill to the neck, which is said to be capable of containing fifteen quarts of water. This bag the bird has a power of wrinkling up into the hollow of the under-chap: but by opening the bill, and putting one's hand down into the bag, it may be distended at pleasure. The skin of which it is formed will then be seen of a bluish ash-colour, with many fibres and veins running over its surface. It is not covered with feathers, but a short downy substance, as smooth and as soft as satin, and is attached all along the under edges of the chap, to be fixed backward to the neck of the bird by proper ligaments, and reaches near half way down. When this bag is empty it is not seen; but when the bird has fished with success, it is then incredible to what an extent it is often seen dilated. For the first thing the pelican does in fishing is to fill up the bag; and then it returns to digest its burden at leisure. When the bill is open to its widest extent, a person may run his head into the bird's mouth, and conceal it in this monstrous pouch, thus adapted for very singular purposes. Yet this is nothing to what Ruysch assures us, who avers, that a man has been seen to hide his whole leg, boot and all, in the monstrous jaws of one of these animals. At first appearance this would seem impossible, as the sides of the under chap, from which the bag depends, are not above an inch asunder when the bird's bill is first opened; but then they are capable of great separation; and it must necessarily be so, as the bird preys upon the largest fishes, and hides them by dozens in its pouch. Tertre affirms, that it will hide as many fish as will serve sixty hungry men for a meal.

Such is the formation of this extraordinary bird, which is a native of Africa and America. The pelican was once also known in Europe, particularly in Russia; but it seems to have deserted our coasts. This is the bird of which so many fabulous accounts have been propagated; such as its feeding its young with its own blood, and its carrying a provision of water for them in its great reservoir in the desert. But the absurdity of the first account answers itself; and as for the latter, the pelican uses its bag for very different purposes than that of filling it with water.

Its amazing pouch may be considered as analogous to the crop in other birds, with this difference, that as theirs lies at the bottom of the gullet, so this is placed at the top.—Thus, as pigeons and other birds macerate their food for their young in their crops, and then supply them, so the pelican supplies its young by a more ready contrivance, and macerates their food in its bill, or stores it for its own particular sustenance.

The ancients were particularly fond of giving this bird admirable qualities and parental affections; struck, perhaps, with its extraordinary figure, they were willing to supply it with as extraordinary appetites; and having found it with a large reservoir, they were pleased with turning it to the most tender and parental uses. But the truth is, the pelican is a very heavy, sluggish, voracious bird, and very ill fitted to take those flights, or to make those cautious provisions for a distant time, which we have been told they do. Father Labat, who seems to have studied their manners with great exactness, has given us a minute history of this bird, as found in America; and from him I will borrow mine.

The pelican, says Labat, has strong wings, furnished with thick plumage of an ash-colour, as are the rest of the feathers over the whole body. Its eyes are very small when compared to the size of its head; there is a sadness in its countenance, and its whole air is melancholy. It is as dull and reluctant in its motions, as the flamingo is sprightly and active. It is slow of flight; and when it rises to fly, performs it with difficulty and labour. Nothing, as it would seem, but the spur of necessity could make these birds change their situation, or induce them to ascend into the air; but they must either starve or fly.

They are torpid and inactive to the last degree, so that nothing can exceed their indolence but their gluttony; it is only from the stimulations of hunger that they are excited to labour; for otherwise they would continue always in fixed repose. When they have raised themselves about thirty or forty feet above the

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bulk and apparent clumsiness, the large extent of their wings, and the extreme lightness of their bones, which are so thin as to be almost transparent, enable these birds to rise to a lofty pitch in the air, to hover at a moderate elevation, or to skim rapidly along the surface of the water with as much facility as they dive into its depths in pursuit of their prey. They sometimes assemble in large numbers, and in this case are said by Buffon to act in concert, and to show no little skill in manœuvring with the view of securing a plentiful quarry, forming themselves into a circular line, and gradually narrowing the extent of the space enclosed, until they have driven the fishes into so small a compass as to render them a certain prey; when at a given signal they all at once plunge into the water and seize upon their terrified victims, filling their pouches with the spoil, and flying to the land, there to devour it at their leisure. This fishery is carried on both at sea and in fresh water.

surface of the sea, they turn their head with one eye downwards, and continue to fly in that posture. As soon as they perceive a fish sufficiently near the surface, they dart down upon it with the swiftness of an arrow, seize it with unerring certainty, and store it up in their pouch. They then rise again, though not without great labour, and continue hovering and fishing, with their head on one side as before.

This work they continue with great effort and industry till their bag is full, and then they fly to land to devour and digest at leisure the fruits of their industry. This, however, it would appear, they are not long in performing; for towards night they have another hungry call, and they again reluctantly go to labour. At night, when their fishing is over, and the toil of the day crowned with success, these lazy birds retire a little way from the shore; and, though with the webbed feet and clumsy figure of a goose, they will be contented to perch no where but upon trees, among the light and airy tenants of the forest. There they take their repose for the night; and often spend a great part of the day, except such times as they are fishing, sitting in dismal solemnity, and, as it would seem, half asleep. Their attitude is, with the head resting upon their great bag, and that resting upon their breast. There they remain without motion, or once changing their situation, till the calls of hunger break their repose, and till they find it indispensably necessary to fill their magazine for a fresh meal. Thus their life is spent between sleeping and eating; and our author adds, that they are as foul as they are voracious, as they are every moment voiding excrements in heaps as large as one's fist.

The same indolent habits seem to attend them even in preparing for incubation, and defending their young when excluded. The female makes no preparation for her nest, nor seems to choose any place in preference to lay in; but drops her eggs on the bare ground to the number of five or six, and there continues to hatch them. Attached to the place, without any desire of defending her eggs or her young, she tamely sits, and suffers them to be taken from under her. Now and then she just ventures to peck, or to cry out when a person offers to beat her off.

She feeds her young with fish macerated for some time in her bag; and when they cry, flies off for a new supply. Labat tells us, that he took two of these when very young, and tied them by the leg to a post stuck into the ground, where he had the pleasure of seeing the old one for several days come to feed them, remaining with them the greatest part of the day, and spending the night on the branch of a tree that hung over them. By these means they were all three become so familiar, that they suffered themselves to be handled; and the young ones very kindly accepted whatever fish he offered them. These they always put first into their bag, and then swallowed at their leisure.

It seems, however, that they are but disagreeable and useless domestics; their gluttony can scarcely be satisfied; their flesh smells very rancid; and tastes a thousand times worse than it smells. The native Americans kill vast numbers; not to eat, for they are not fit even for the banquet of a savage; but to convert their large bags into purses and tobacco pouches. They bestow no small pains in dressing the skin with salt and ashes, rubbing it well with oil, and then forming it to their purpose. It thus becomes so soft and pliant, that the Spanish women sometimes adorn it with gold and embroidery to make work-bags of.

Yet with all the seeming habitudes of this bird, it is not entirely incapable of instruction in a domestic state. Father Raymond assures us, that he has seen one so tame and well educated among the native Americans, that it would go off in the morning at the word of command, and return before night to its master, with its great pouch distended with plunder; a part of which the savages would make it disgorge, and a part they would permit it to reserve for itself.

"The pelican," as Faber relates, "is not destitute of other qualifications. One of these which was brought alive to the duke of Bavaria's court, where it lived forty years, seemed to be possessed of very uncommon sensations. It was much delighted in the company and conversation of men, and in music both vocal and instrumental: for it would willingly stand," says he, "by those that sung, or sounded the trumpet; and stretching out its head, and turning its ear to the music, listened very attentively to its harmony; though its own voice was little pleasanter than the braying of an ass." Gesner tells us, that the emperor Maximilian had a tame pelican, which lived for above eighty years, and that always attended his army on their march. It was one of the largest of the kind, and had a daily allowance by the emperor's orders. As another proof of the great age to which the pelican lives, Aldrovandus makes mention of one of these birds that was kept several years at Mechlin, which was verily believed to be fifty years old.—We often see these birds at our shows about town.

CHAP. III.

OF THE ALBATROSS, THE FIRST OF THE GULL KIND.[1]

Though this is one of the largest and most formidable birds of Africa and America, yet we have but few accounts to enlighten us in its history. The figure of the bird is thus described by Edwards: "The body is rather larger than that of a pelican; and its wings, when extended, ten feet from tip to tip. The bill, which is six inches long, is yellowish, and terminates in a crooked point. The top of the head is of a bright brown; the back is of a dirty deep spotted brown; and the belly and under the wings is white; the toes, which are webbed, are of a flesh colour."

Such are the principal traits in this bird's

[1] The ocean has its own peculiar birds as well as the land. Compelled to traverse incessantly its solitudes to obtain their subsistence, they are endowed with a wonderful power of flight, so that in a few hours they are able to cross immense distances, and to betake themselves to those places to which their instinct directs them. Among these numerous tribes there exist distinctions of manners as decided as the physical characters by which they are classified; and this induces us to give the name of birds of the ocean (*oiseaux pelagiens*), properly so called, to the petrels and the albatrosses. The former are found in every sea, under every meridian, and in almost every latitude. Except the short time which they devote to rearing their young, all the rest of their life is occupied in traversing the ocean, and laboriously seeking, in the midst of storms, a scanty sustenance, almost as soon digested as procured; which seems to place them under subjection to a single duty, that of obtaining nourishment.

Boobies (*Sula Bassana*), noddies (*Sterna*), men of war birds (*Pelecanus Aquilus*, L.), and tropic birds (*Phaeton erubescens*)—although they occasionally take long flights over the sea, do not deserve the name of birds of the ocean: they simply make excursions; and preferring their lonely cliffs to the rocking of the waves, they generally return to them every evening.

The discrimination of the several species of albatross has become a matter of great difficulty, from the many different names that successive travellers have bestowed upon them, and from the difference between the sexes, as well as from the change which takes place in the same individual at different ages and at different seasons of the year.

The greatest number of albatrosses are met with between the 55th and 59th parallel of latitude; and probably in that direction they may have no boundary but the polar ice. Although they are to be met with over the whole of this vast space, there are some places for which they have a preference, and in which they are found in greater numbers than elsewhere. They are most abundant about the Cape of Good Hope and about Cape Horn, and both these places are well known to be almost constantly the scenes of very violent storms. The petrels are more numerous, and more widely diffused, since they are to be met with from pole to pole, and they vary very much in size. The albatross is distinguishable by its great size; but one species of the petrel (*Procellaria gigantea*) is nearly as large, while another species is as different from this as a sparrow from a goose.

It is certain that fish do serve for food to the albatross and petrel, although they were never seen pursuing the flying-fish, which are said to fall a prey to them when they leave the deep, and, betaking themselves to their wings to avoid the enemy in the water, only encounter a new danger in the albatross; nor were any remains, either of these or of the mollusca—which, as it were, cover these seas, and would alone be sufficient to satisfy one of these birds for a whole day—ever found in their stomachs. We have seen them surrounded with sea-blubbers, physaliæ, Salpæ, &c., but these afforded them no nourishment; they invariably sought other food. This was not the case with cuttlefish and calmars, fragments of which were constantly found in their stomachs.

One circumstance which could not escape notice during our long voyages, is the habit—we should almost say the necessity—which these birds are under of frequenting rough seas. The tempest itself does not alarm them; and when the wind is blowing most furiously, they may be seen wheeling about without appearing at all affected by it.—When, on the other hand, the face of the ocean is smoothed by a calm, they fly to other regions, again to appear with the return of winds and storms. No doubt the reason of this is, that the agitation of the waves brings to their surface those marine animals which serve for food to these birds. It is from the same reason that they keep near the eddying and disturbance occasioned by the passing of a vessel through the water. This design was clearly demonstrated to us when approaching the Cape of Good Hope. We were accompanied by a great number of small petrels, of the size of kingfishers, who were busy skimming the surface of the water in a line of exactly the width of our track. None were to be seen anywhere else. We took great care that nothing should be thrown from the corvette, and yet we saw them every instant darting their bills into the water to seize some object which we were unable to distinguish.

The duration, the rapidity, the strength, and the manner of flight of these birds in general, has been a subject of study and astonishment to us. Their agility in casting themselves, like a harpoon, on their prey, in raising it with their beak, their activity in striking the backs of the waves with their foot, or in traversing their long unsteady ridges, were sometimes the only spectacle which the solitudes of the ocean had to offer to us.

One of the peculiar characters of these palmipedes (web-footed birds) is, that their flight is effected almost entirely by sailing as it were through the air. If they do sometimes flap their wings, it is in order to raise themselves more quickly; but such instances are rare. In the albatross, which was principally remarked upon, both from its great size and from its approaching nearer to the ships, it was observed that their long wings were concave underneath, and that they did not show any apparent vibration in whatever position the bird might be; whether when skimming the surface of the wave they regulated their flight by its undulations, or when rising into the air they described wide circles around the vessel.

Land birds of prey who fly in this way without moving their wings, are generally descending towards the earth when they adopt this mode of flight; while the petrel and the albatross easily raise themselves up into the air, turn quickly round by means of their tail, and go on in the face of the highest wind without their progress appearing to be at all diminished by its force, and without any apparent motion being imparted to their wings. But still we must admit that some impulse is given to the air which sustains them—although we cannot perceive it, it is true, since it probably is exerted at the end of very long levers (at the extremities of their wings); for, otherwise, we cannot conceive how the pro-

figure: but these lead us a very short way in its history; and our naturalists have thought fit to say nothing more. However, I am apt to believe this bird to be the same with that described by Wicquefort, under the title of the Alcatraz; its size, its colours, and its prey, incline me to think so. He describes it as a kind of great gull, as large in the body as a goose, of a brown colour, with a long bill, and living upon fish, of which they kill great numbers.

This bird is an inhabitant of the tropical climates, and also beyond them as far as the Straits of Magellan in the South seas. It is one of the most fierce and formidable of the aquatic tribe, not only living upon fish, but also such small water-fowl as it can take by surprise. It preys, as all the gull kind do, upon the wing; and chiefly pursues the flying-fish, that are forced from the sea by the dolphins. The ocean in that part of the world presents a very different appearance from the seas with which we are surrounded. In our seas we see nothing but a dreary expanse, ruffled by winds, and seeming forsaken by every class of animated nature. But the tropical seas, and the distant southern latitudes beyond them, are all alive with birds and fishes, pursuing and pursued. Every various species of the gull kind are there seen hovering on the wing, at a thousand miles' distance from the shore. The flying fish are every moment rising to escape from their pursuers of the deep, only to encounter equal dangers in the air. Just as they rise the dolphin is seen to dart after them, but generally in vain; the gull has more frequent success, and often takes them at their rise; while the albatross pursues the gull, and obliges it to relinquish its prey; so that the whole horizon presents but one living picture of rapacity and evasion.

So much is certain; but how far we are to credit Wicquefort, in what he adds concerning this bird, the reader is left to determine. "As these birds, except when they breed, live entirely remote from land, so they are often seen, as it should seem, sleeping in the air. At night, when they are pressed by slumber, they rise into the clouds as high as they can; there, putting their head under one wing, they beat the air with the other, and seem to take their ease. After a time, however, the weight of their bodies, only thus half supported, brings them down; and they are seen descending, with a pretty rapid motion, to the surface of the sea. Upon this they again put forth their efforts to rise; and thus alternately ascend and descend at their ease. But it sometimes happens," says my author, "that in these slumbering flights, they are off their guard, and fall upon deck, where they are taken."

What truth there may be in this account I will not take upon me to determine: but certain it is, that few birds float upon the air with more ease than the albatross, or support themselves a longer time in that element. They seem never to feel the accesses of fatigue; but night and day upon the wing, are always prowling, yet always emaciated and hungry.

But though this bird be one of the most formidable tyrants of the deep, there are some associations which even tyrants themselves form, to which they are induced either by caprice or necessity. The albatross seems to have a peculiar affection for the penguin, and a pleasure in its society. They are always seen to choose the same places for breeding; some distant uninhabited island, where the ground slants to the sea, as the penguin is not formed either for flying or climbing. In such places their nests are seen together, as if they stood in need of mutual assistance and protection. Captain Hunt, who for some time commanded at our settlement upon Falkland islands, assures me, that he was often amazed at the union preserved between these birds, and the regularity with which they built together. In that bleak and desolate spot, where the birds had long continued undisturbed possessors, and no way dreaded the encroachment of men, they seemed to make their abode as comfortable as they expected it to be lasting. They were seen to build with an amazing degree of uniformity; their nests covering fields by thousands, and resembling a regular plantation. In the middle, on high, the albatross raised its nest, on heath, sticks, and long grass, about two feet above the sur-

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gressive motion of the animal is accomplished. The exceedingly long wings which many of these birds possess, spoil the beauty of their figure when closed, as they produce a thickness in the posterior part of the body. It is when flying that they display themselves to the greatest advantage; and they are endowed with a wonderful strength to enable them to perform their flights. When in 59° south latitude, where there is scarcely any night as long as the sun is under the tropic of Capricorn, we have seen the same petrels sailing on the wing several days together without interruption. The petrels do not dive after their food, but if it lies only at a certain depth, they endeavour to seize it by forcing part of their body under water.

From what has been said, it appears, that the mere presence of these birds is not a sure sign of the approach of land.

With respect to the incubation of these pelagic birds, the French naturalists observe that the petrels flock in immense numbers to the "Isles Malouines," along the shores of which their eggs are deposited in such abundance as to be a source of subsistence to the seamen employed in the seal-fishery. They were also informed that these birds arrange their eggs with much order, and, living as it were in a republic, exercise by turns the function of incubation in this kind of temporary establishment.—*Zoological Magazine.*

face: round this the penguins made their lower settlement, rather in holes in the ground, and most usually eight penguins to one albatross. Nothing is a stronger proof of Mr Buffon's fine observation, that the presence of man not only destroys the society of meaner animals, but their instincts also. These nests are now, I am told, totally destroyed; the society is broke up; and the albatross and penguin have gone to breed upon more desert shores, in greater security.[1]

CHAP. V.

THE CORMORANT.[2]



The Cormorant is above the size of a large Muscovy duck, and may be distinguished from all other birds of this kind, by its four toes being united by membranes together; and by the middle toe being toothed or notched like a saw, to assist it in holding its fishy prey. The head and neck of this bird are of a sooty blackness; and the body thick and heavy, more inclined in figure to that of the goose than the gull. The bill is straight, till near the end, where the upper chap bends into a hook.

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[1] The Albatross is also called the man-of-war bird. In the West Indies these birds are said to foretell the arrival of ships; which is frequently true, and may arise from a very natural cause. They always fish in fine weather; so that, when the wind is rough at sea, they retire into the harbours, where they are protected by the land; and the same wind that blows them in, brings likewise whatever vessels may be exposed to its fury, to seek a retreat from it. They devour fish with great gluttony and are often so gorged as to be unable to fly. Their cry resembles the braying of an ass.

The *Chocolate Albatross*.—This bird inhabits the Pacific Ocean, and is three feet long. The bill is whitish; the body of a deep chestnut brown colour; belly pale; face and wings beneath whitish. The irides are brown; the legs bluish white, with white claws.

Yellow-Nosed Albatross.—The colour is white; the bill is black; keel of the upper mandible, and base of the lower one yellow; the body above is of a black-blue colour; beneath it is white. It inhabits the Pacific ocean, and is about three feet long. The irides are brown; the nape of the neck and rump, white; the legs are pale yellow; the fore-part and connected membrane dusky.

[2] Although the cormorant appears to have been always common upon our coasts, and of known extensive distribution throughout the maritime districts of the north of Europe, it is only within the last few years that the changes of plumage to which it is subject, have been perfectly investigated, and that the mistakes of earlier writers have been corrected by the observations of Montagu, Temminck, and other eminent ornithologists. It has been described by several as a distinct species when in its summer or nuptial plumage. Some have considered this state as indicative only of the male bird, whilst others have regarded it as a common or an accidental variety. It is now, however, well ascertained, that, on the approach of spring, *both sexes* invariably undergo the change that assimilates them to the *Crested Cormorant* of Bewick and others, and which garb they retain till after reproduction has been effected. This I have had repeated opportunities of verifying from my own observations, and by the dissection of many specimens from a colony that annually breed at the Fern islands on the Northumbrian coast. This bird is perhaps generally looked on with dislike, from an association of ideas produced by the extravagant descriptions of different authors, and from the prominent part it is made to perform in the sublime poem of "Paradise Lost." As naturalists, however, and believers in the unerring wisdom so greatly and wonderfully displayed throughout the animated creation, we are not to judge of its qualities from the exaggerations of fancy, but to consider whether its powers are not fitly and beautifully adapted to the place it is destined to fill in the great chain of the universe. Viewed in this, the only true light, we shall find much to admire, since its instincts and habits are in such perfect accordance with, and so ably support, the economy of its being. So far, indeed, from possessing the bad qualities attributed to it, it seems, from the testimony of Montagu, to be endowed with a nature directly the reverse; for he states, that he found it extremely docile, of a grateful disposition, and without the smallest tincture of a savage or vindictive spirit. This character I can confirm, from having kept it in a domesticated state; and the very fact, indeed, of these birds having been trained to fish, as many of the *Falconidæ* are to fowl, is a further proof of its docility and tractable nature. Like other piscivorous birds, its digestion is rapid, and its consumption of food consequently great, but the epithet of glutton, and the accusation of unrelenting cruelty, are no more applicable to it, than to any other bird destined by its Creator to prey on living matter. In Britain, where it is numerous and widely dispersed, the Cormorant breeds upon rocky shores and islands, selecting the *summits* of the rocks for the situation of the nest, and not (like the Green Cormorant) the clefts or ledges. In some countries it breeds upon trees, possessing, as I have before observed, the power of grasping firmly with its feet. Upon the Fern islands, its nest is composed entirely of a mass of sea-weed, frequently heaped up to the height of two feet, in which are deposited from three to five eggs, of a pale bluish-white, with a rough surface, from the unequal deposition of the calcareous matter. The young, when first hatched, are quite naked and very ugly, the skin being of a purplish-black; this in six or seven days becomes clothed with a thick black down, but the feathered plumage is not perfected in less than five or six weeks. Instinct, that powerful substitute for reason, is no where more beautifully exemplified than in the young of this bird; for I have repeatedly found, that, upon being thrown into the sea, even when scarcely half-fledged, they immediately plunge beneath the surface, and endeavour to escape by diving. This they will do to a great distance, using their imperfect wings, and pursuing their submarine flight in the same manner,

But notwithstanding the seeming heaviness of its make, there are few birds more powerfully predaceous. As soon as the winter approaches, they are seen dispersed along the sea-shore, and ascending up the mouths of fresh-water rivers, carrying destruction to all the finny tribe. They are most remarkably voracious, and have a most sudden digestion. Their appetite is for ever craving, and never satisfied. This gnawing sensation may probably be increased by the great quantity of small worms that fill their intestines, and which their unceasing gluttony contributes to engender.

Thus formed with the grossest appetites, this unclean bird has the most rank and disagreeable smell, and is more fetid than even carrion, when in its most healthful state. Its form, says an ingenious modern, is disagreeable; its voice is hoarse and croaking; and all its qualities obscene. No wonder then that Milton should make Satan personate this bird, when he sent him upon the basest purposes, to survey with pain the beauties of Paradise, and to sit devising death on the tree of life.[1] It has been remarked, however, of our poet, that the making a water-fowl perch upon a tree, implied no great acquaintance with the history of nature. In vindication of Milton, Aristotle expressly says, that the cormorant is the only water-fowl that sits on trees. We have already seen the pelican of this number; and the cormorant's toes seem as fit for perching upon trees as for swimming; so that our epic bard seems to have been as deeply versed in natural history as in criticism.

Indeed this bird seems to be of a multiform nature; and wherever fish are to be found, watches their migrations. It is seen as well by land as sea; it fishes in fresh-water lakes, as well as in the depths of the ocean; it builds in the cliffs of rocks, as well as on trees; and preys not only in the day-time, but by night.

Its indefatigable nature, and its great power in catching fish, were probably the motives that induced some nations to breed this bird up tame, for the purpose of fishing; and Willoughby assures us, it was once used in England for that purpose. The description of their manner of fishing is thus delivered by Faber.

"When they carry them out of the rooms where they are kept, to the fish-pools, they hoodwink them, that they may not be frighted by the way. When they are come to the rivers, they take off their hoods; and having tied a leather thong round the lower part of their necks, that they may not swallow down the fish they catch, they throw them into the river. They presently dive under water, and there for a long time, with wonderful swiftness, pursue the fish; and when they have caught them, rise to the top of the water, and pressing the fish lightly with their bills, swallow them; till each bird hath, after this manner, devoured five or six fishes. Then their keepers call them to the fist, to which they readily fly; and, one after another, vomit up all their fish, a little bruised with the first nip, given in catching them. When they have done fishing, setting their birds on some high place, they loose the string from their necks, leaving the passage to the stomach free and open; and, for their reward, they throw them part of their prey; to each one or two fishes, which they will catch most dexterously, as they are falling in the air.

At present the cormorant is trained in every part of China for the same purpose, where there are many lakes and canals. "To this end," says Le Compte, "they are educated as men rear up spaniels or hawks, and one man can easily manage a hundred. The fisher carries them out into the lake, perched on the gunnel of his boat, where they continue tranquil, and expecting his orders with patience. When arrived at the

and with almost as much effect, as their parents. When unfledged in the nest, the young of this species, if alarmed by an approach, raise the head and neck to the full stretch, at the same time gaping wide, and vibrating in a curious manner the loose skin of the neck and throat, accompanied by a constant and querulous cry. In winter, cormorants are frequently seen in our rivers and lakes at a considerable distance from the sea, where they occasionally perch and roost in such trees as grow upon the immediate banks. They feed entirely on fish, which they obtain by active pursuit beneath the surface of the water, and having the gullet very large and dilatable, they are enabled to swallow those of considerable size. The prey is killed by being squeezed in their powerful and hooked bill, and always swallowed head foremost; and should the fish happen to have been awkwardly captured for this operation, it is tossed into the air, and in descending caught in a more favourable position. In swimming, the body of this bird is almost entirely submerged, the head and part of the neck only being visible. Montagu also observes, that when in the act of looking for its prey, it always carries the head under water, being able thus to discover it at a greater distance than if the eyes were kept above the surface, which is generally in some degree agitated. It may frequently be observed standing upon the shore or rocks, with the wings expanded, for several minutes at a time, in order to dry the feathers and bring them to the proper state for preening, as they are apt to become wet from long continued diving, causing the gradual loss of the oily matter that partly defends them from the action of the water. This species is a native of the new as well as of the ancient continent, being found in various parts of North America; it is also met with in Northern Asia, and in Europe its distribution is wide, extending to high latitudes. The bronchi in this bird are of great length, and of equal diameter, issuing from the lower larynx, which is formed of a single cartilaginous ring. Immediately below the glottis, the tube is enlarged, but soon contracts, and remains of the same diameter through the rest of its course.—*Selby's British Ornithology, Vol. II.*

[1] Vide Pennant's Zoology, p. 477.

proper place, at the first signal given each flies a different way to fulfil the task assigned it. It is very pleasant, on this occasion, to behold with what sagacity they portion out the lake or the canal where they are upon duty. They hunt about, they plunge, they rise a hundred times to the surface, until they have at last found their prey. They then seize it with their beak by the middle, and carry it without fail to their master. When the fish is too large, they then give each other mutual assistance: one seizes it by the head, the other by the tail, and in this manner carry it to the boat together. There the boatman stretches out one of his long oars, on which they perch, and being delivered of their burden, they fly off to pursue their sport. When they are wearied, he lets them rest for a while; but they are never fed till their work is over. In this manner, they supply a very plentiful table; but still their natural gluttony cannot be reclaimed even by education. They have always while they fish the same string fastened round their throats, to prevent them from devouring their prey, as otherwise they would at once satiate themselves, and discontinue their pursuit the moment they had filled their bellies."

As for the rest, the cormorant is the best fisher of all birds; and though fat and heavy with the quantity it devours, is nevertheless generally upon the wing. The great activity with which it pursues, and from a vast height drops down to dive after its prey, offers one of the most amusing spectacles to those who stand upon a cliff on the shore. This large bird is seldom seen in the air, but where there are fish below; but then they must be near the surface, before it will venture to souse upon them. If they are at a depth beyond what the impetus of its flight makes the cormorant capable of diving to, they certainly escape him; for this bird cannot move so fast under water, as the fish can swim. It seldom, however, makes an unsuccessful dip; and is often seen rising heavily, with a fish larger than it can readily devour. It sometimes also happens, that the cormorant has caught the fish by the tail; and consequently the fins prevent its being easily swallowed in that position. In this case, the bird is seen to toss its prey above its head, and very dexterously to catch it, when descending, by the proper end, and so swallow it with ease.

CHAP. V.

OF THE GANNET, OR SOLAN GOOSE.



The Gannet is of the size of a tame goose, but its wings much longer, being six feet

[1] Although the Gannet (or, as it is more frequently called in Scotland, the Solan Goose) deserts its breeding stations and the northern coasts of the kingdom upon the approach of autumn, it is occasionally found throughout the winter in the English channel, where it keeps at a distance from the land, feeding upon the pilchards and herrings, which at that season retire to the deeper parts of the ocean. The main body of these birds, however, appears to seek more southern latitudes, as they are met with in great numbers during winter in the Bay of Biscay, on the coasts of Spain and Portugal, and in the Mediterranean; and here they find an abundant supply of the anchovy and sardine, both species of *Clupea* (herring). They generally make their appearance about the end of March or beginning of April, in the vicinity of their breeding stations: these are the isle of Ailsa, at the mouth of the Frith of Clyde; St Kilda; Souliskerry near the Orkneys; the Skelig isles upon the Irish coast, and the Bass Rock at the entrance of the Frith of Forth. Upon the precipitous rocks of these islands they breed in innumerable multitudes, occupying all the ledges and summits wherever they find sufficient space for the nest, which is formed of a mass of sea-weed, and other materials, which they either find on the rocky cliffs, or gather from the surface of the sea as they pass on the wing. They lay but one egg each (not two, as stated by Temminck), exceeding in size that of the cormorant, but much less than the egg of the common goose, with which it has been compared. Its colour, when first laid, is white, but it soon becomes soiled, and as incubation proceeds, acquires a yellowish or clay-coloured appearance. The young, when hatched, are naked, their skin smooth and of bluish-black, but covered in a few days with a white down, which, growing rapidly, soon becomes very thick, giving them in this state the appearance of large powder-puffs, or masses of cotton. Over this warm clothing, the regular plumage gradually extends; and after about two months they are fully fledged and able to take wing. Great numbers of the young birds are annually taken upon the Bass Rock, not merely on account of the feathers and down, for the *bodies* are also sold in the neighbouring towns, and in the Edinburgh market, at the rate of 1s. 8d. each, being much esteemed, when roasted, as a relish a short time before the hour of dinner. Their flesh is very oily and rank, and though habit has reconciled the Scotch to such an unusual whet, few strangers would find their appetites increased, after partaking of such a dish. This precipitous rock (the *Bass*) is rented from the proprietor at £60 or £70

over. The bill is six inches long, straight almost to the point, where it inclines down, and the sides are irregularly jagged, that it may hold its prey with greater security. It differs from the cormorant in size, being larger; and its colour, which is chiefly white; and by its having no nostrils, but in their place a long furrow that reaches almost to the end of the bill. From the corner of the mouth is a narrow slip of black bare skin, that extends to the hind part of the head; beneath the skin is another that, like the pouch of the pelican, is dilatable, and of size sufficient to contain five or six entire herrings, which in the breeding season it carries at once to its mate or its young.

These birds, which subsist entirely upon fish, chiefly resort to those uninhabited islands where their food is found in plenty, and men seldom come to disturb them. The islands to the north of Scotland, the Skelig islands off the coasts of Kerry in Ireland, and those that lie in the north sea off Norway, abound with them. But it is on the Bass island, in the Frith of Edinburgh, where they are seen in the greatest abundance. "There is a small island," says the celebrated Harvey, "called the Bass, not more than a mile in circumference. The surface is almost wholly covered during the months of May and June with their nests, their eggs, and young. It is scarcely possible to walk without treading on them: the flocks of birds upon the wing, are so numerous, as to darken the air like a cloud; and their noise is such, that one cannot without difficulty be heard by the person next to him. When one looks down upon the sea from the precipice, its whole surface seems covered with infinite numbers of birds of different kinds, swimming and pursuing their prey. If, in sailing round the island, one surveys its hanging cliffs, in every crag, or fissure of the broken rocks, may be seen innumerable birds, of various sorts and sizes, more than the stars of heaven, when viewed in a serene night. If they are viewed at a distance, either receding, or in their approach to the island, they seem like one vast swarm of bees."

They are not less frequent upon the rocks

per annum,* and as the proceeds chiefly depend upon the produce of the gannets, great care is taken to protect the old birds, which the tenant is enabled to do from the privilege possessed by the proprietor, of preventing any person from shooting or otherwise destroying them within a certain limited distance of the island. From the accounts I have received from the resident there, it appears that the gannet is a very long-lived bird, as he has recognised, from particular and well-known marks, certain individuals for upwards of forty years, that invariably returned to the same spot to breed. He also confirmed to me the time required for this bird to attain maturity, viz. four years; and pointed out several in the different garbs they assume during that period, stating also, that until fully matured, they have never been known to breed. During incubation, in consequence of being unmolested, they become very tame; and, where the nests are easily accessible upon the flat surface of the rock on the south-west side of the island, will allow themselves to be stroked by the hand without resistance, or any show even of impatience, except the low guttural cry of *grog, grog*. Upon the other breeding stations above mentioned, the produce of the gannet is equally prized, and immense numbers, both of the eggs and young, are annually taken, and preserved by the inhabitants for winter's consumption. From the great development of the wings, and the peculiar apparatus of air-cells distributed over different parts of the body, the flight of this bird is powerful and buoyant, and can be supported for any length of time. When in search of prey, it soars usually at a considerable elevation, as it thus obtains a sufficient impetus in its fall to reach the fish beneath the surface; at other times, when making its way to any distant point, or in dark and stormy weather, it flies comparatively low. Its food consists almost entirely of the different species of herring, which it always takes by plunging vertically upon them as they rise within a certain distance of the top of the water. The force with which it descends in this operation, may be conceived from the fact of gannets having been taken by a fish fastened to a board sunk to the depth of two fathoms, in which cases the neck has either been found dislocated, or the bill firmly fixed in the wood. Pennant, and some other writers, describe this bird as having a gular pouch similar to that of the pelican, and capable of containing five or six herrings; this, however, is not correct, as that part is not more dilatable than the rest of the gullet, which, as well as the skin of the neck, can occasionally stretch to much extent, readily allowing a passage to the largest herring, or even to a fish of still greater dimensions. Montagu observes, that he was not able to keep the gannet alive in confinement; but this probably arose from the want of a due supply of fish, as I have known them to live for a long time in a domesticated state, and my friend Mr Neill of Canonmills, near Edinburgh, (well known to the scientific world as a botanist and a lover of natural history), has at present, or at least within a very late period had, one in the full enjoyment of health for many years past. This bird, when herrings could not be procured, was fed with flounders, which it swallowed with the greatest apparent ease, the gape readily accomodating itself to their greater breadth. It is almost unnecessary to add, that all fish are swallowed with the head foremost. Sometimes the gannet becomes so gorged with food, as to be compelled to alight on the water, and to repose there in a lethargic state; and when thus situated, it may, by being advanced upon in a boat from the windward, be easily run down and captured. This arises from its being unable to leave the water except when breasting the wind, and it never makes any attempt to dive, of which power it seems to be totally divested. This species is widely distributed throughout the northern parts of Europe, and is also common to North America. The body of this bird is long and much flattened, with the neck elongated, and thick and muscular, in order to support its powerful bill; the wings are of great length, the radius (or second joint) measuring fully eight inches; and the legs are not placed so far behind as in the cormorants, so that the horizontal position is preserved in walking. In its affinities it seems to connect the true pelicans with the genera *Tachypetes* and *Phæton*.—*Selby's British Ornithology.*

* Other statements make the rental only £30.

of St Kilda. Martin assures us, that the inhabitants of that small island consume annually near twenty-three thousand young birds of this species, besides an amazing quantity of their eggs. On these they principally subsist throughout the year; and from the number of these visitants, make an estimate of their plenty for the season. They preserve both the eggs and fowls in small pyramidal stone buildings, covering them with turf ashes, to prevent the evaporation of their moisture.

The gannet is a bird of passage. In winter it seeks the more southern coasts of Cornwall, hovering over the shoals of herrings and pilchards that then come down from the northern seas; its first appearance in the northern islands is in the beginning of spring; and it continues to breed till the end of summer. But, in general, its motions are determined by the migrations of the immense shoals of herrings that come pouring down at that season through the British Channel, and supply all Europe, as well as this bird, with their spoil. The gannet assiduously attends the shoal in their passage, keeps with them in their whole circuit round our island, and shares with our fishermen this exhaustless banquet. As it is strong of wing, it never comes near the land; but is constant to its prey. Wherever the gannet is seen, it is sure to announce to the fishermen the arrival of the finny tribe; they then prepare their nets, and take the herrings by millions at a draught; while the gannet, who came to give the first information, comes, though an unbidden guest, and often snatches its prey from the fisherman even in his boat. While the fishing season continues, the gannets are busily employed; but when the pilchards disappear from our coasts, the gannet takes its leave to keep them company.

The cormorant has been remarked for the quickness of his sight; yet in this the gannet seems to exceed him. It is possessed of a transparent membrane under the eye-lid, with which it covers the whole eye at pleasure, without obscuring the sight in the smallest degree. This seems a necessary provision for the security of the eyes of so weighty a creature, whose method of taking its prey, like that of the cormorant, is by darting headlong down from a height of a hundred feet or more into the water to seize it.—These birds are sometimes taken at sea, by fastening a pilchard to a board, which they leave floating. The gannet instantly pounces down from above upon the board, and is killed or maimed by the shock of a body where it expected no resistance.

These birds breed but once a year, and lay but one egg, which being taken away, they lay another; if that is also taken, then a third; but never more for that season. Their egg is white, and rather less than that of the common goose; and their nest large, composed of such substances as are found floating on the surface of the sea. The young birds, during the first year, differ greatly in colour from the old ones; being of a dusky hue, speckled with numerous triangular white spots; and at that time resembling the colours of the speckled diver.

The Bass island, where they chiefly breed,[1] belongs to one proprietor; so that care is taken never to fright away the birds when laying, or to shoot them upon the wing. By that means, they are so confident as to alight and feed their young ones close beside you. They feed only upon fish, as was observed; yet the young gannet is counted a great dainty by the Scots, and is sold very dear; so that the lord of the islet makes a considerable annual profit by the sale.

CHAP. VI.

OF THE SMALLER GULLS AND PETRELS.

Having described the manners of the great ones of this tribe, those of the smaller kinds may be easily inferred. They resemble the more powerful in their appetites for prey, but have not such certain methods of obtaining it. In general, therefore, the industry of this tribe, and their audacity, increase in proportion to their imbecility; the great gulls live at the most remote distance from man; the smaller are obliged to reside wherever they can take their prey; and to come into the most populous places, when solitude can no longer grant them a supply. In this class we may place the Gull, properly so called, of which there are above twenty different kinds; the Petrel, of which there are three; and the Sea-swallow, of which there are as many. The gulls may be distinguished by an angular knob on the lower chap; the petrels by their wanting this knob; and the sea-swallow by their bills, which are straight, slender, and sharp-pointed. They all, however, agree in their appetites, and their places of abode.[2]

[1] Solan Geese also frequent *Ailsa Craig*, an insulated rock in the Frith of Clyde, somewhat similar in appearance to the Bass, but nearly double its size in circumference and height.

[2] Besides the faculty of swimming, *Petrels* possess that of supporting themselves on the water, by striking very rapidly with their feet, which has caused them to be compared to *St Peter* walking upon the water. Hence the name. The petrels are to be seen in all seas of the globe from one pole to the other. They are the inseparable companions of mariners, during their long navigations. The flight of these birds is almost al-

The gull, and all its varieties, is very well known in every part of the kingdom. It is seen with a slow-sailing flight, hovering over rivers to prey upon the smaller kinds of fish; it is seen following the ploughman in fallow fields to pick up insects; and when living animal food does not offer, it has even been known to eat carrion, and whatever else of

ways performed by hovering, and without presenting apparent vibrations. They rise with facility, and can fly against the strongest winds, which never slacken their movements. The tempest not only does not affright them, but they are almost necessitated to seek those seas where the agitation of the waves brings to the surface those marine animals which constitute their food. In consequence of this, they are frequently seen in all weathers, in the vortices which are formed by the track of vessels. The following cut represents the common *Stormy Petrel*.



The *Little Stormy Petrel* breeds in the Orkneys. Mr Scarth states that, in passing over a tract of peat-moss, near the shore, in a small uninhabited island in Orkney, one evening in the month of August, he was surprised to hear a low, purring noise, somewhat resembling the sound of a spinning-wheel in motion; and, on inquiry, he was informed by one of the boatmen who accompanied him, that it was the noise commonly emited by the Alimonty (the Orkney name for the stormy petrel, that frequented the island when hatching. On examining a small hole in the ground, he found the bird and its nest, which was very simple, being little more than a few fragments of shells laid on the bare turf. It contained two round, pure-white eggs, which were very large in comparison with the size of the bird. [*One* egg is the more usual production of the Petrel.] When he seized the bird, she squirted out of her mouth an oily substance of a very rancid smell. He took her home, and having put her into a cage, he offered her various kinds of worms to eat; but, as far as he could observe, she ate nothing till after the expiration of four days, when he observed that she occasionally drew the feathers of her breast singly across, or rather through her bill, and appeared to suck an oily substance from them. This induced him to smear her breast with common train oil; and, observing that she greedily sucked the feathers, he repeated the smearing two or three times in each day for about a week. He then placed a saucer containing oil in the cage, and observed that she regularly extracted the oil by dipping her breast in the vessel, and then sucked the feathers as before. In this way he kept her for three months. After feeding, she sat quietly at the bottom of the cage, sometimes making the same purring noise which first attracted his notice and sometimes whistling very shrilly. "There are," says Wilson, "few persons who have crossed the Atlantic that have not observed these solitary wanderers of the deep, skimming along the surface of the wild and wasteful ocean; flitting past the vessel like swallows, or following in her wake, gleaning their scanty pittance of food from the rough and whirling surges. Habited in mourning, and making their appearance generally in greater numbers previous to or during a storm, they have long been fearfully regarded by the ignorant and superstitious, not only as the foreboding messengers of tempests and dangers to the hapless mariner, but as wicked agents, connected some how or other in creating them. 'Nobody,' say they, 'can tell any thing of where they come from, or how they breed, though (as sailors sometimes say) it is supposed that they hatch their eggs under their wings as they sit on the water.' This mysterious uncertainty of their origin, and the circumstances above recited, have doubtless given rise to the opinion, so prevalent among this class of men, that they are in some way or other connected with the prince of the power of the air. In every country where they are known, their names have borne some affinity to this belief. They have been called witches, stormy petrels, the Devil's birds and Mother Cary's chickens, probably from some celebrated ideal hag of that name; and their unexpected and numerous appearance has frequently thrown a momentary damp over the mind of the hardiest seamen. It is the business of the naturalist, and the glory of philosophy, to examine into the reality of these things; to dissipate the clouds of error and superstition wherever they darken and bewilder the human understanding, and to illustrate nature with the radiance of truth." When we inquire, accordingly, into the unvarnished history of this ominous bird, we find that it is by no means peculiar in presaging storms, for many others of very different families are evidently endowed with an equally nice perception of a change in the atmosphere. Hence it is that, before rain swallows are seen more eagerly hawking for flies, and ducks carefully trimming their feathers, and tossing up water over their backs, to try whether it will run off again without wetting them. But it would be as absurd to accuse the swallows and ducks on that account of being the cause of rain, as to impute a tempest to the spiteful malice of the poor petrels. Seamen ought rather to be thankful to them for the warning which their delicate feelings of aerial change enable them to give of an approaching hurricane. "As well," says Wilson, "might they curse the midnight light-house that, star-like, guides them on their watery way; or the buoy that warns them of the sunken rocks below, as this harmless wanderer, whose manner informs them of the approach of the storm, and thereby enables them to prepare for it." The petrels are nocturnal birds. When, therefore, they are seen flying about and feeding by day, the fact appears to indicate that they have been driven from their usual quarters by a storm; and hence, perhaps, arose the association of the bird with the tempest. Though the petrels venture to wing their way over the wide ocean, as fearlessly as our swallows do over a mill-pond, they are not, therefore, the less sensible to danger; and, as if feelingly aware of their own weakness, they make all haste to the nearest shelter. When they cannot then find an island or a rock to shield them from the blast, they fly towards the first ship they can descry, crowd into her wake, and even close under the stern, heedless, it would appear, of the rushing surge, so that they can keep the vessel between them and the unbroken sweep of the wind. It is not to be wondered at, in such cases, that their low wailing note of *weet, weet*, should add something supernatural to the roar of waves and whistling of the wind, and infuse an ominous dread into minds prone to superstition. The popular opinion among sailors, that the petrels carry their eggs under their wings in order to hatch them, is no less unfounded than the fancy of their causing storms: it is, indeed, physically impossible. On the contrary, the petrels have been ascertained to breed on rocky shores, in numerous communities, like the bank-swallow, making their nests in the holes and cavities of the rocks above the sea, returning to feed their young only during the night, with the superabundant oily food from their stomachs. The

the kind that offers. Gulls are found in great plenty in every place; but it is chiefly round our boldest rockiest shores that they are seen in the greatest abundance; it is there that the gull breeds and brings up its young; it is there that millions of them are heard screaming with discordant notes for months together.

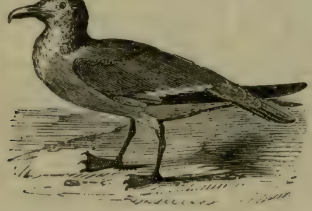
Those who have been much upon our coasts know that there are two different kinds of shores; that which slants down to the water with a gentle declivity, and that which rises with a precipitate boldness, and seems set as a bulwark to repel the force of the invading deeps. It is to such shores as these that the whole tribe of the gull kind resort, as the rocks offer them a retreat for their young, and the sea a sufficient supply. It is in the cavities of these rocks, of which the shore is composed, that the vast variety of sea-fowls retire to breed in safety. The waves beneath, that continually beat at the base, often wear the shore into an impending boldness; so that it seems to jut out over the water, while the raging of the sea makes the place inaccessible from below. These are the situations to which sea-fowl chiefly resort, and bring up their young in undisturbed security.

Those who have never observed our boldest coasts, have no idea of their tremendous sublimity. The boasted works of art, the highest towers, and the noblest domes, are but ant-hills when put in comparison: the single cavity of a rock often exhibits a coping higher than the ceiling of a Gothic cathedral. The face of the shore offers to the view a wall of massive stone, ten times higher than our tallest steeples. What should we think of a precipice three quarters of a mile in height? and yet the rocks of St Kilda are still higher! What must be our awe to approach the edge of that impending height, and to look down on the unfathomable vacuity below; to ponder on the terrors of falling to the bottom, where

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quantity of this oily matter is so considerable, that, in the Faro Isles, they use petrels for candles, with no other preparation than drawing a wick through the body of the birds from the mouth to the rump.

The *Gulls*, Buffon terms the vultures of the sea, for they feed upon carcasses of every description, which are either floating on its surface, or cast upon its shores. They swarm upon the borders of the sea, where they seek fish, either fresh or corrupted, flesh in the same states, worms, or mollusca, all of which their stomach is capable of digesting. Spread throughout the entire globe, they cover with their multitudes the shores, rocks, and cliffs, causing them to re-echo with their clamours. There are even some species which frequent the fresh waters, and some are to be met with at sea, at more than a hundred leagues distant from land. D'Azara, who has seen them, in innumerable quantities, near the slaughter houses of Monte Video, Buenos Ayres, and even in the squares, where they pick up the offal of the shambles, &c., and sometimes perch on the roofs, tells us that they proceed considerably to inland, whither they are attracted by dead animals. They dart with such violence on their prey, that they will swallow both bait and hook, and spit themselves on the point placed by the fisher under the fish which he presents to them. It is, therefore, very natural that they should pursue individuals of their own species, in whose possession they see any food, a fact, moreover, of which we are constant eye-witnesses in other species, such as sparrows, hens, &c. The following cut represents a *Common Gull*. Gulls have been found by navigators in all latitudes; they are, however, both more numerous and larger in the northern regions, where the carcasses of large fishes and cetacea present them with more abundant food, and it is on the desert islands of the two polar zones, where they are undisturbed, that they prefer to nestle. They deposit their eggs either in a hole upon the sand, or in the crevices of rocks; but in less deserted countries the smaller species seek the borders of waters, or of the sea, which are covered with plants. The *Sea-mew* is a species of gull, distinguished from the rest by its black and white pie-bald appearance, although the individuals vary from each other in the colour of their plumage.



The *Terns* have been also called *Sea Swallows*, from the resemblance of their forked tail, long wings, and their constant habit of shaving the surface of the water in all directions, in pursuit of small fish. But the term is objectionable, as tending to the inter-confusion of birds of such different orders, and such essential differences of conformation and habits. The terns are continually on the wing, and, though webfooted, are not seen to swim; they rest but seldom, and only on the land; their food consists, for the most part, of small fish and mollusca, which they seize upon the surface of the water; but they also catch aerial insects. In flying they send forth sharp and piercing cries, especially during nestling time. In calm weather they sometime rise very high, and are often seen to come plump down. The young differ from the adult and aged, only before the moulting, which is double in the known species, and there is no external difference between the two sexes. The females deposit their eggs, usually two or three in number, in a cavity, and these nests are sometimes so close, that the sitting birds touch each other. Terns are found in both continents, from the seas, lakes, and rivers of the north, as far as the vast coasts of the Austral ocean, and in almost all the intermediate climates. The above cut represents a *Common Tern*



the waves that swell like mountains are scarcely seen to curl on the surface, and the roar of an ocean a thousand leagues broad appears softer than the murmur of a brook! it is in these formidable mansions that myriads of sea-fowls are for ever seen sporting, flying in security down the depth, half a mile beneath the feet of the spectator. The crow and the chough avoid those frightful precipices; they choose smaller heights, where they are less exposed to the tempest; it is the cormorant, the gannet, the tarrock, and the tern, that venture to these dreadful retreats, and claim an undisturbed possession. To the spectator from above, those birds, though some of them are above the size of an eagle, seem scarcely as large as a swallow; and their loudest screaming is scarcely perceptible.

But the generality of our shores are not so formidable. Though they may rise two hundred fathoms above the surface, yet it often happens that the water forsakes the shores at the departure of the tide, and leaves a noble and delightful walk for curiosity on the beach. Not to mention the variety of shells with which the sand is strewed, the lofty rocks that hang over the spectator's head, and that seem but just kept from falling, produce in him no unpleasing gloom. If to this be added the fluttering, the screaming, and the pursuits of myriads of water-birds, all either intent on the duties of incubation, or roused at the presence of a stranger, nothing can compose a scene of more peculiar solemnity. To walk along the shore when the tide is departed, or to sit in the hollow of a rock when it is come in, attentive to the various sounds that gather on every side, above and below, may raise the mind to its highest and noblest exertions. The solemn roar of the waves swelling into and subsiding from the vast caverns beneath, the piercing note of the gull, the frequent chatter of the guillemot, the loud note of the hawk, the scream of the heron, and the hoarse deep periodical croaking of the cormorant, all unite to furnish out the grandeur of the scene, and turn the mind to HIM who is the essence of all sublimity.

Yet it often happens that the contemplation of a seashore produces ideas of an humbler kind, yet still not unpleasing. The various arts of these birds to seize their prey, and sometimes to elude their pursuers, their society among each other, and their tenderness and care of their young, produce gentler sensations. It is ridiculous also now and then to see their various ways of imposing upon each other. It is common enough, for instance, with the arctic gull, to pursue the lesser gulls so long, that they drop their excrements through fear, which the hungry hunter quickly gobbles up before it ever reaches the water. In breeding too they have frequent contests; one bird who has no nest of her own, attempts to dispossess another, and puts herself in the place. This often happens among all the gull-kind: and I have seen the poor bird, thus displaced by her more powerful invader, sit near the nest in pensive discontent, while the other seemed quite comfortable in her new habitation. Yet this place of pre-eminence is not easily obtained; for the instant the invader goes to snatch a momentary sustenance, the other enters upon her own, and always ventures another battle before she relinquishes the justness of her claim. The contemplation of a cliff thus covered with hatching birds, affords a very agreeable entertainment; and as they sit upon the ledges of the rocks, one above another, with their white breasts forward, the whole group has not unaptly been compared to an apothecary's shop.

These birds, like all others of the rapacious kind, lay but few eggs; and hence, in many places, their number is daily seen to diminish. The lessening of so many rapacious birds may, at first sight, appear a benefit to mankind; but when we consider how many of the natives of our islands are sustained by their flesh, either fresh or salted, we shall find no satisfaction in thinking that these poor people may in time lose their chief support. The gull, in general, as was said, builds on the ledges of rocks, and lays from one egg to three, in a nest formed of long grass and seaweed. Most of the kind are fishy tasted, with black stringy flesh; yet the young ones are better food: and of these, with several other birds of the penguin kind, the poor inhabitants of our northern islands make their wretched banquets. They have been long used to no other food; and even salted gull can be relished by those who know no better. Almost all delicacy is a relative thing; and the man who repines at the luxuries of a well-served table, starves not for want, but from comparison. The luxuries of the poor are indeed coarse to us, yet still they are luxuries to those ignorant of better; and it is probable enough that a Kilda or a Feroe man may be found to exist, outdoing Apicius himself in consulting the pleasures of the table. Indeed, if it be true that such meat as is the most dangerously earned is the sweetest, no men can dine so luxuriously as these, as none venture so hardily in the pursuit of a dinner. In Jacobson's History of the Feroe islands, we have an account of the method in which those birds are taken; and I will deliver it in his own simple manner.

"It cannot be expressed with what pains and danger they take these birds in those high steep cliffs, whereof many are two hundred

fathoms high. But there are men apt by nature, and fit for the work, who take them usually in two manners; they either climb from below into these high promontories, that are as steep as a wall; or they let themselves down with a rope from above. When they climb from below, they have a pole five or six ells long with an iron hook at the end, which they that are below in the boat, or on the cliff, fasten unto the man's girdle, helping him up thus to the highest place where he can get footing; afterwards they also help up another man; and thus several climb up as high as they possibly can; and, where they find difficulty, they help each other up, by thrusting one another up with their poles. When the first hath taken footing, he draws the other up to him, by the rope fastened to his waist; and so they proceed, till they come to the place where the birds build. They there go about as well as they can in those dangerous places; the one holding the rope at one end, and fixing himself to the rock; the other going at the other end from place to place. If it should happen that he chanceth to fall, the other that stands firm keeps him up, and helps him up again. But if he passeth safe, he likewise fastens himself till the other has passed the same dangerous place also. Thus they go about the cliffs after birds as they please. It often happeneth, however, (the more is the pity) that when one doth not stand fast enough, or is not sufficiently strong to hold up the other in his fall, that they both fall down, and are killed. In this manner some do perish every year."

Mr Peter Clanson, in his description of Norway, writes, that there was anciently a law in that country, that whosoever climbed so on the cliffs that he fell down and died, if the body was found before burial, his next kinsman should go the same way; but if he durst not, or could not do it, the dead body was not then to be buried in sanctified earth, as the person was too full of temerity, and his own destroyer.

"When the fowlers are come, in the manner aforesaid, to the birds within the cliffs, where people seldom come, the birds are so tame, that they take them with their hands; for they will not readily leave their young. But when they are wild, they cast a net, with which they are provided, over them, and entangle them therein. In the meantime, there lieth a boat beneath in the sea, wherein they cast the birds killed; and, in this manner, they can in a short time fill a boat with fowl. When it is pretty fair weather, and there is good fowling, the fowlers stay in the cliff seven or eight days together; for there are here and there holes in the rocks, where they can safely rest; and they have meat let down to them with a line from the top of the mountain. In the meantime some go every day to them, to fetch home what they have taken.

"Some rocks are so difficult, that they can in no manner get unto them from below; wherefore they seek to come down thereunto from above. For this purpose they have a rope eighty or a hundred fathoms long, made of hemp, and three fingers thick. The fowler maketh the end of this fast about his waist, and between his legs, so that he can sit thereon; and is thus let down, with the fowling-staff in his hand. Six men hold by the rope, and let him easily down, laying a large piece of wood on the brink of the rock, upon which the rope glideth, that it may not be worn to pieces by the hard and rough edge of the stone. They have, besides, another small line, that is fastened to the fowler's body; on which he pulleth, to give them notice how they should let down the great rope, either lower or higher; or to hold still, that he may stay in the place whereunto he is come. Here the man is in great danger, because of the stones that are loosened from the cliff, by the swinging of the rope, and he cannot avoid them. To remedy this, in some measure, he hath usually on his head a seaman's thick and shaggy cap, which defends him from the blows of the stones, if they be not too big; and then it costeth him his life; nevertheless, they continually put themselves in that danger, for the wretched body's food sake, hoping in God's mercy and protection, unto which the greatest part of them do devoutly recommend themselves when they go to work: otherwise, they say, there is no other great danger in it, except that it is a toilsome and artificial labour; for he that hath not learned to be so let down, and is not used thereto, is turned about with the rope, so that he soon groweth giddy, and can do nothing; but he that hath learned the art, considers it as a sport, swings himself on the rope, sets his feet against the rock, casts himself some fathoms from thence, and shoots himself to what place he will: he knows where the birds are, he understands how to sit on the line in the air, and how to hold the fowling-staff in his hand; striking therewith the birds that come or fly away: and when there are holes in the rocks, and it stretches itself out, making underneath as a ceiling under which the birds are, he knoweth how to shoot himself in among them, and there take firm footing. There, when he is in these holes, he maketh himself loose of the rope, which he fastens to a crag of the rock, that it may not slip from him to the outside of the cliff. He then goes about in the rock, taking the fowl either with his hands or the fowling-staff. Thus, when he hath killed as many birds as he thinks fit, he

ties them in a bundle, and fastens them to a little rope, giving a sign, by pulling, that they should draw them up. When he has wrought thus the whole day, and desires to get up again, he sitteth once more upon the great rope, giving a new sign that they should pull him up; or else he worketh himself up, climbing along the rope, with his girdle full of birds. It is also usual, where there are not folks enough to hold the great rope, for the fowler to drive a post sloping into the earth, and to make a rope fast therefrom, by which he lets himself down without any body's help, to work in the manner aforesaid. Some rocks are so formed that the person can go into their cavities by land.

"These manners are more terrible and dangerous to see than to describe; especially if one considers the steepness and height of the rocks, it seeming impossible for a man to approach them, much less to climb or descend. In some places, the fowlers are seen climbing where they can only fasten the ends of their toes and fingers; not shunning such places, though there be a hundred fathom between them and the sea. It is a dear meat for these poor people, for which they must venture their lives; and many, after long venturing, do at last perish therein.

"When the fowl is brought home, a part thereof is eaten fresh; another part, when there is much taken, being hung up for winter provision. The feathers are gathered to make merchandise of, for other expenses. The inhabitants get a great many of these fowls, as God giveth his blessing and fit weather. When it is dark and hazy, they take most; for then the birds stay in the rocks: but in clear weather, and hot sunshine, they seek the sea. When they prepare to depart for the season, they keep themselves most there, sitting on the cliffs towards the sea-side, where people get at them sometimes with boats, and take them with fowling-staves."

Such is the account of this historian; but we are not to suppose that all the birds caught in this manner are of the gull kind: on the contrary, numbers of them are of the penguin kind; auks, puffins, and guillemots. These all come, once a season, to breed in these recesses; and retire in winter to fish in more southern climates.[1]

[1] By many of the earlier systematists, the skuas were included in the gulls, but as essential characteristics (not possessed by the former), are developed in their structure, particularly in the bill, feet, and tail, and as a marked difference also exists in their habits, it has been considered necessary to establish a distinct genus for their reception. They are the determined enemies of the gulls, whom they unceasingly persecute on the wing, in order to make them disgorge their half digested or recently swallowed food, and which is then adroitly caught by the former before it can reach the water. They also feed upon the flesh of the whale and other marine animal substances. An approach to the petrels is seen in their general contour, and in the structure of their feet, the hind toe in some species consisting of little more than a nail. Their wings are long and pointed, and their flight, which is strong, and at times astonishingly rapid, is performed by successive jerks (in each of which a considerable curve is described), bearing but little resemblance to that of the true gulls. They are natives of the arctic regions, and are found, particularly during the season of reproduction, in very high latitudes. The plumage of both sexes is alike, but some species undergo great changes in their progress to maturity.

Common Skua.—Provincial.—*Sea-eagle*, *Bonxie*, or *Skui*. This bird, which appears to be the largest of its genus, is of compact form, and bold disposition; which latter quality is more especially seen during the season of reproduction, a period when the instinctive passions of the feathered race are called into unwonted activity. It will at that time attack even man without hesitation, should he happen to approach the site of its nest; and so impetuous is its attack, that the natives of the Shetland isles (its peculiar habitat in this kingdom) are compelled on such occasions to defend themselves by holding up a knife, or sharp stick; upon which the assailant has frequently been known to transfix and kill itself, whilst making its pounces upon the head of the intruder. Dogs, foxes, and other animals, are instantly attacked, and so severely dealt with by the wings and beak of the strong and pugnacious skua, as to be soon driven to a hasty retreat, and no bird is permitted to approach with impunity; the eagle itself being beaten off with the utmost fury, should it happen to venture within the limits of the breeding territory. As above observed, it inhabits the Shetland isles, breeding in communities upon Foulah, Unst, and Rona's hill in Mainland. It selects the wild and unfrequented heaths for the site of its nest, which is formed of a few dried weeds and grasses; and its eggs, two in number, are of a dark oil-green colour, blotched with irregular brown spots, with smaller whitish ones intermixed. After performing the duties of incubation, it retires to the adjacent seas, where it leads a solitary life, rarely approaching the land till the advance of spring again urges it to seek its summer retreat. It is but seldom found in the southern parts of Scotland, and the instances of its capture upon the English coast are of still rarer occurrence, Montagu only mentioning one, of a bird that was shot at Sandwich, in Kent. The food of the skua consists of fish, the carcasses of cetacea, and other marine animal matter; a great part of which is obtained from the larger gulls, whom it attentively watches, and pursues with unceasing hostility, till they are compelled to disgorge the fish or other substance that they had previously swallowed, and which, from its rapid evolutions on the wing, it generally catches before reaching the surface of the water. In this, as well as in the other species, the claws are strong and much hooked, particularly that of the inner toe; and it is said to make use of them in holding fast its prey, which is torn in pieces after the manner of raptorial birds. The skua inhabits also

CHAP. VII.

OF THE PENGUIN KIND: AND FIRST, OF THE GREAT MAGELLANIC PENGUIN.

The gulls are long-winged, swift flyers, that hover over the most extensive seas, and

dart down upon such fish as approach too near the surface. The penguin[1] kind are but ill fitted for flight, and still less for walking. Every body must have seen the awkward manner in which a duck, either wild or tame, attempts to change place: they must recollect with what softness and ease a gull or a kite waves its pinions, and with what a coil and flutter the duck attempts to move them; how many strokes it is obliged to give, in order to gather a little air; and even when it is thus raised, how soon it is fatigued with the force of its exertions, and obliged to take rest again. But the duck is not, in its natural state, half so unwieldly an animal as the whole tribe of the penguin kind. Their wings are much shorter, more scantily furnished with quills, and the whole pinion placed too forward to be usefully employed. For this reason, the largest of the penguin kind, that have a thick heavy body to raise, cannot fly at all. Their wings serve them rather as paddles to help them forward, when they attempt to move swiftly, and in a manner walk along the surface of the water. Even the smallest kinds seldom fly by choice; they flutter their wings with the swiftest efforts without making way; and though they have but a small weight of body to sustain, yet they seldom venture to quit the water, where they are provided with food and protection.

As the wings of the penguin tribe are unfitted for flight, their legs are still more awkwardly adapted for walking. This whole tribe have all above the knee hid within the belly: and nothing appears but two short legs, or feet, as some would call them, that seem stuck under the rump, and upon which the animal is very awkwardly supported. They seem, when sitting, or attempting to walk, like a dog, that has been taught to sit up, or to move a minuet. Their short legs drive

various parts of the arctic regions, and is well known in the Feroe islands, in Norway, and Iceland. It is, moreover, a native of the high latitudes of the southern hemisphere, and is mentioned by Cook, and other circumnavigators, under the name of the Port Egmont hen. Dr Fleming observes, that the feathers of these birds have a very strong smell, not unlike that peculiar to the petrels, to which genus they show much affinity. (For a representation of Richardson's Skua, see Plate XIX. fig. 43.)

[1] In the "Zoological Proceedings for 1835" is an account of the penguin, by the late Mr G. Bennett. That able naturalist, to whom science is indebted for many original observations, and whose work, entitled "Wanderings," &c., is well known, paid much attention to the *Patagonian*, or *King Penguin* (see Plate XX. fig. 34.) which he met with in various islands in the high southern latitudes; and he describes particularly a colony of these birds, which covers an extent of thirty or forty acres at the north end of Macquarrie island, in the South Pacific ocean.

"The number of penguins collected together in this spot is immense, but it would be almost impossible to guess at it with any near approach to truth, as, during the whole of the day and night, 30,000 or 40,000 of them are continually landing, and an equal number going to sea. They are arranged, when on shore, in as compact a manner and in as regular ranks as a regiment of soldiers; and are classed with the greatest order, the young birds being in one situation, the moulting birds in another, the sitting hens in a third, the clean birds in a fourth, &c.; and so strictly do birds in similar condition congregate, that should a bird that is moulting intrude itself among those which are clean, it is immediately ejected from among them.

"The females hatch the eggs by keeping them close between their thighs; and, if approached during the time of incubation, move away, carrying the eggs with them. At this time the male bird goes to sea and collects food for the female, which becomes very fat. After the young is hatched, both parents go to sea, and bring home food for it; it soon becomes so fat as scarcely to be able to walk, the old birds getting very thin. They sit quite upright in their roosting places, and walk in the erect position until they arrive at the beach, when they throw themselves on their breasts in order to encounter the very heavy sea met with at their landing-place.

Although the appearance of penguins generally indicates the neighbourhood of land, Mr G. Bennet cited several instances of their occurrence at a considerable distance from any known land.

The observations of Mr Bennet are confirmed by Lieut. Liardet. They assemble on the shore, herd together in vast bodies, forming a dense phalanx, all moving and acting in concert together;—one party going off to sea,—another party returning,—another remaining in array on the beach. They appear to be very peaceable among each other, but are sometimes observed to fight, striking with the posterior edge of the wing. Should a person attempt to lay hold of them, they not only use their wings, but their beak, which is a far more formidable weapon, and capable of inflicting a severe wound. Cuttle-fishes appear to constitute the greater part of their food; in the stomach of the specimen dissected was found a considerable number of the horney parrot-like beaks of these molluscous animals. Their mode of walking is very singular; it is a sort of awkward waddle, the body turning with the action of the limbs in motion, which cross each other alternately;—it is, in fact, an "over-handed," mode of progression, if the word be allowed, producing a strange and ludicrous effect. We see a tendency to it in the waddle of the duck and other swimming-birds. During the period of incubation the females all assemble together, sitting upright on a kind of general nest, of loosely-arranged sticks, which they carry to the selected spot in their bills, and flourish if then approached, as if in defiance of the intruder on their secluded haunt. They lay but one egg, of a whitish colour, and twice the size of that of the goose; this they carry between their thighs, supporting it beneath by the short stiff tail, which is bent underneath it. The young are covered with thick soft down, of a brownish gray; in this state the bird is the Woolly penguin of Latham, which must not be regarded as a distinct species, but as the King Penguin in nestling plumage. At night they utter loud moaning noises in concert, the general chorus of voices resounding to a great distance, and clearly distinguishable from the roar of the surf or lashing of the waves. The flesh of the penguin is rank, and unfit for food; both the muscles and bones are oily, and the skin is lined with a thick layer of oleaginous fat; yet more than 500 were taken in New Year's island (near Staten island), as food for the crew, by the sailors in Captain Cook's ship who found them occupying that spot in thousands.

the body in progression from side to side; and were they not assisted by their wings, they could scarcely move faster than a tortoise.

This awkward position of the legs, which so unqualifies them for living upon land, adapts them admirably for a residence in water. In that, the legs placed behind the moving body, pushes it forward with the greater velocity; and these birds, like Indian canoes, are the swiftest in the water, by having their paddles in the rear. Our sailors, for this reason, give these birds the very homely, but expressive, name of *arse-feet*.

Nor are they less qualified for diving than swimming. By ever so little inclining their bodies forward, they lose their centre of gravity; and every stroke from their feet only tends to sink them the faster. In this manner they can either dive at once to the bottom, or swim between two waters; where they continue fishing for some minutes, and then ascending, catch an instantaneous breath, to descend once more to renew their operations. Hence it is, that these birds, which are so defenceless, and so easily taken by land, are impregnable by water. If they perceive themselves pursued in the least, they instantly sink, and show nothing more than their bills, till the enemy is withdrawn. Their very internal conformation assists their power of keeping long under water. Their lungs are fitted with numerous vacuities, by which they can take in a very large inspiration; and this probably serves them for a length of time.

As they never visit land, except when they come to breed, their feathers take a colour from their situation. That part of them which has been continually bathed in the water, is white; while their backs and wings are of different colours, according to the different species. They are also covered more warmly all over the body with feathers, than any other birds whatever; so that the sea seems entirely their element: and but for the necessary duties of propagating their species, we should scarcely have the smallest opportunity of seeing them, and should be utterly unacquainted with their history.[1]

[1] The *Crested Penguin*, (see Plate XX. fig. 33.) is the most beautiful of the penguin tribe. It is nearly two feet in length. The female is destitute of the crest. These birds have also the names of hopping penguins, and jumping jack, from their action of leaping quite out of the water, sometimes three or four feet, on meeting with any obstacle in their course; and, indeed, they frequently do this without any other apparent cause than the desire of advancing by that means. They are inhabitants of several of the South Sea islands.

The *Manchots* bear a close relation to the penguins, but are found only in the antarctic seas and islands, while the penguins inhabit the northern seas. Instead of wings, they have simple winglets, which perform the office of oars or fins.

Of all this tribe, the Magellanic Penguin is the largest, and the most remarkable. In size it approaches near that of a tame goose. It never flies, as its wings are very short, and covered with stiff hard feathers, and are always seen expanded, and hanging uselessly down by the bird's sides. The upper part of the head, back, and rump, are covered with stiff black feathers; while the belly and breast, as is common with all of this kind, are of a snowy whiteness, except a line of black that is seen to cross the crop. The bill, which from the base to about half way is covered with wrinkles, is black, but marked crosswise with a stripe of yellow. They walk erect, with their heads on high, their fin-like wings hanging down like arms; so that to see them at a distance, they look like so many children with white aprons. From hence they are said to unite in themselves the qualities of men, fowls, and fishes. Like men, they are upright; like fowls, they are feathered; and like fishes, they have fin-like instruments, that beat the water before, and serve for all the purposes of swimming, rather than flying.[2]

[2] "This day we visited what they call a 'penguin rookery.' The spot of ground occupied by our settlers is bounded on each end by high *bluffs*, which extend far into the sea, leaving a space in front, where all their hogs run nearly wild, as they are prevented going beyond those limits by those natural barriers; and the creatures who, at stated periods, come up from the sea, remain in undisturbed possession of the beaches beyond our immediate vicinity. The weather being favourable, we launched our boat early in the morning, for the purpose of procuring a supply of eggs for the consumption of the family. We heard the chattering of the penguins from the rookery long before we landed, which was noisy in the extreme, and groups of them were scattered all over the beach; but the high thick grass on the declivity of the hill seemed their grand establishment, and they were hidden by it from our view. As we could not find any place where we could possibly land our boat in safety, I and two more swam on shore with bags tied round our necks to hold the eggs in, and the boat with one of the men lay off, out of the surf. I should think the ground occupied by these *birds* (if I may be allowed so to call them) was at least a mile in circumference, covered in every part with grasses and reeds, which grew considerably higher than my head; and on every gentle ascent, beginning from the beach, on all the large gray rocks, which occasionally appeared above this grass, sat perched groups of these strange and uncouth-looking creatures; but the noise which rose up from beneath baffles all description! As our business lay with the noisy part of this community, we quickly crept under the grass, and commenced our plundering search, though there needed none, so profuse was the quantity. The scene altogether well merits a better description than I can give—thousands and hundreds of thousands of these little two-legged erect monsters hopping around us, with voices very much resembling in tone that of the human; all opening their throats together; so thickly clustered in groups, that it was almost impossible to place the foot without despatching one of them. The shape of the animal, their curious motions, and their most extraordinary voices, made me

They feed upon fish; and seldom come ashore, except in the breeding season. As the seas in that part of the world abound with a variety, they seldom want food; and their extreme fatness, seems a proof of the plenty in which they live. They dive with great rapidity, and are voracious to a great degree. One of them, described by Clusius, though but very young, would swallow an entire herring at a mouthful, and often three successively before it was appeased. In consequence of this gluttonous appetite, their flesh is rank and fishy; though our sailors say, that *it is pretty good eating.* In some the flesh is so tough, and the feathers so thick, that they stand the blow of a scimitar without injury.

They are a bird of society; and, especially when they come on shore, they are seen drawn up in rank and file, upon the ledge of a rock, standing together with the albatross, as if in consultation. This is previous to their laying, which generally begins, in that part of the world, in the month of November. Their preparations for laying are attended with no great trouble, as a small depression in the earth, without any other nest, serves for this purpose. The warmth of their feathers and the heat of their bodies is such, that the progress of incubation is carried on very rapidly.

But there is a difference in the manner of this bird's nestling in other countries, which I can only ascribe to the frequent disturbances it has received from man or quadrupeds in its recesses. In some places, instead of contenting itself with a superficial depression in the earth, the penguin is found to burrow two or three yards deep: in other places it is seen to forsake the level, and to clamber up the ledge of a rock, where it lays its egg, and hatches it in that bleak exposed situation. These precautions may probably have been taken, in consequence of dear-bought experience. In those places where the bird fears for her own safety, or that of her young, she may providently provide against danger, by digging, or even by climbing; for both which she is but ill adapted by nature. In those places, however, where the penguin has had but few visits from man, her nest is made, with the most confident security, in the middle of some large plain, where they are seen by thousands. In that unguarded situation, neither expecting nor fearing a powerful enemy, they continue to sit brooding; and even when man comes among them, have at first no apprehension of their danger. Some of this tribe have been called by our seamen, *the Booby*,[1] from the total insensibility which they show when they are sought to their destruction. But it is not considered that these birds have never been taught to know the dangers of a human enemy: it is against the fox or the vulture that they have learned to defend themselves; but they have no idea of injury from a being so very unlike their natural opposers. The penguins, therefore, when our seamen first came among them, tamely suffered themselves to be knocked on the head, without even attempting an escape. They have stood to be shot at in flocks, with-

fancy myself in a kingdom of pigmies. The regularity of their manners, their all sitting in exact rows, resembling more the order of a camp than a rookery of noisy birds, delighted me. These creatures did not move away on our approach, but only increased their noise, so we were obliged to displace them forcibly from their nests; and this ejectment was not produced without a considerable struggle on their parts; and, being armed with a formidable beak, it soon became a scene of desperate warfare. We had to take particular care to protect our hands and legs from their attacks; and for this purpose each one had provided himself with a short stout club. The noise they continued to make during our ramble through their territories, the sailors said was, 'cover 'em up, cover 'em up.' And, however incredible it may appear, it is nevertheless true, that I heard those words so distinctly repeated, and by such various tones of voices, that several times I started, and expected to see one of the men at my elbow. Even these little creatures, as well as the monstrous sea-elephant, appear to keep up a continued warfare with each other. As the penguins sit in rows, forming regular lanes leading down to the beach, whenever one of them feels an inclination to refresh herself by a plunge into the sea, she has to run the gauntlet through the whole *street*, every one pecking at her as she passes without mercy; and though all are occupied in the same employment, not the smallest degree of friendship seems to exist; and whenever we turned one off her nest, she was sure to be thrown among foes; and, besides the loss of her eggs, was invariably doomed to receive a severe beating and pecking from her companions. Each one lays three eggs, and, after a time, when the young are strong enough to undertake the journey, they go to sea, and are not again seen till the ensuing spring. Their city is deserted of its numerous inhabitants, and quietness reigns till nature prompts their return the following year, when the same noisy scene is repeated, as the same flocks of birds return to the spot where they were hatched. After raising a tremendous tumult in this numerous colony, and sustaining continued combat, we came off victorious, making capture of about a thousand eggs, resembling in size, colour, and transparency of shell, those of a duck; and the taking possession of this immense quantity did not occupy more than one hour, which may serve to prove the incalculable numbers of birds collected together. We did not allow them sufficient time, after landing, to lay all their eggs; for, had the season been farther advanced, and we had found three eggs in each nest, the whole of them might probably have proved addled, the young partly formed, and the eggs of no use to us; but the whole of those we took turned out good, and had a particularly fine and delicate flavour. It was a work of considerable difficulty to get our booty safe into the boat—so frail a cargo—with so tremendous a surf running against us. However, we finally succeeded, though not without smashing a considerable number of the eggs."—*Earle's 'Narrative of a Residence in New Zealand and Tristan d'Acunha.'*

[1] The Booby belongs to the pelican tribe, and not to the penguins.

out offering to move, in silent wonder, till every one of their number has been destroyed. Their attachment to their nests was still more powerful; for the females tamely suffered the men to approach and take their eggs without any resistance. But the experience of a few of those unfriendly visits, has long since taught them to be more upon their guard in choosing their situations; or to leave those retreats where they were so little able to oppose their invaders.

The penguin lays but one egg; and, in frequented shores, is found to burrow like a rabbit: sometimes three or four take possession of one hole, and hatch their young together. In the holes of the rocks, where nature has made them a retreat, several of this tribe, as Linnæus assures us, are seen together. There the females lay their single egg, in a common nest, and sit upon this, their general possession, by turns; while one is placed as a sentinel, to give warning of approaching danger. The egg of the penguin, as well as of all this tribe, is very large for the size of the bird, being generally found bigger than that of a goose. But as there are many varieties of the penguin, and as they differ in size, from that of a Muscovy duck to a swan, the eggs differ in the same proportion.

CHAP. VIII.

OF THE AUK, PUFFIN, AND OTHER BIRDS OF THE PENGUIN KIND.

Of a size far inferior to the penguin, but with nearly the same form, and exactly of the same appetites and manners, there is a very numerous tribe. These frequent our shores, and, like the penguin, have their legs placed behind. They have short wings, which are not totally incapable of flight; with round bills for seizing their prey, which is fish. They live upon the water, in which they are continually seen diving; and seldom venture upon land, except for the purposes of continuing their kind.

The first of this smaller tribe is the Great Northern Diver, which is nearly the size of a goose: it is beautifully variegated all over with many strips, and differs from the penguin, in being much slenderer, and more elegantly formed. The Gray Speckled Diver does not exceed the size of a Muscovy duck; and, except in size, greatly resembles the former. The Auk, which breeds on the islands of St Kilda, chiefly differs from the penguin in size and colour: it is smaller than a duck; and the whole of the breast and belly, as far as the middle of the throat, is white. The Guillemot is about the same size; it differs from the auk, in having a longer, a slenderer, and a straighter bill. The Scarlet-Throated Diver may be distinguished by its name; and the Puffin, or Coulterneb, is one of the most remarkable birds we know.[1]

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[1] *The Great Northern Diver*, (see Plate XIX. fig. 41.) which is the principal of the auk tribe, is nearly three feet and a half in length. The female is less than the male. It inhabits chiefly the northern seas, and is common on some of the coasts of Scotland.

Most people, who have exercised any degree of observation, know that the swimming of birds is nothing more than a walking in the water, where one foot succeeds the other, as on the land. "But no one, as far as I am aware," says the Rev. Mr White, "has remarked, that diving fowls, while under water, impel and row themselves forward by a motion of their wings, as well as by the impulse of their feet; yet such is really the case, as any one may easily be convinced who will observe ducks when hunted by dogs in a clear pond. Nor do I know that any one has given a reason why the wings of diving fowls are placed so forward; doubtless not for the purpose of promoting their speed in flying, since that position certainly impedes it; but probably for the increase of their motion under water, by the use of four oars instead of two: and were the wings and feet nearer together, as in land birds, they would, when in action, rather hinder than assist one another."

The Speckled Diver is not quite so large as the other.

The Great Auk. (See Plate XX. fig. 32.)—This bird inhabits Europe and America; is three feet in length; is very timid; it has not the power of flying; its food is chiefly fishes. The wings are so short as to appear as only rudiments; secondary quill feathers tipt with white; the legs are black. Its egg is six inches long, and white, with purplish lines and spots. *The Little Auk* also inhabits Europe and America, and measures nine inches in length.

The Guillemot is about the size of a common duck. The upper parts of the body are of a dark brown colour, inclining to a black. These are simple birds, and easily taken. They generally join company with other birds, and breed on the inaccessible rocks and steep cliffs in the Isle of Man; and likewise in Cornwall; on Priesholm Island, near Beaumaris, in the isle of Anglesey; also on the Fern Islands, near Northumberland: and the cliffs about Scarborough, in Yorkshire; and several other places in England. They lay exceeding large eggs, being full three inches long, blunt at the one end, sharp at the other, of a sort of bluish colour, spotted generally with some black spots or strokes. (For little Guillemot, see Plate XIX. fig. 23.)

The Black Guillemot.—The length of the black Guillemot is about fourteen inches, breadth twenty-two, and its weight fourteen ounces. These birds are found in great numbers in the north sea, in Greenland, Iceland, Spitzbergen, and the Feroe isles; and when the winter sets in, they migrate southward along the shores of Scotland and England, where some of them remain and breed. The nest is made in the deep crevices of rocks which overhang the sea; the eggs are of a gray colour. Some ornithologists assert, that the female lays only one: others, that she lays two. They fly commonly in pairs, and so low that they raise the surface of the sea by the flapping of their narrow wings. The Greenlanders eat the flesh of this bird, and use its skin for clothing, and the legs as a bait for their fishing-lines. Ray, Albin, Willoughby, and Edwards have named it the Greenland dove, or sea-turtle. In the Orkneys it is called the tyste.

The *Grebes* belong to this family of birds. They are

Words cannot easily describe the form of the bill of the puffin, which differs so greatly from that of any other bird. Those who have seen the coulter of a plough, may form some idea of the beak of this odd-looking animal. The bill is flat; but, very different from that of a duck, its edge is upwards: it is of a triangular figure, and ending in a sharp point, the upper chap bent a little downward, where it is joined to the head; and a certain callous substance encompassing its base, as in parrots. It is of two colours; ash-coloured near the base, and red towards the point. It has three furrows or grooves impressed in it; one in the livid part, two in the red. The eyes are fenced with a protuberant skin, of a livid colour; and they are gray or ash-coloured. These are marks sufficient to distinguish this bird by; but its value to those in whose vicinity it breeds, renders it still more an object of curiosity.

The puffin, (see Plate XX. fig. 9.) like all the rest of this kind, has its legs thrown so far back, that it can hardly move without tumbling. This makes it rise with difficulty, and subject to many falls before it gets upon the wing: but as it is a small bird, not much bigger than a pigeon, when it once rises, it can continue its flight with great celerity.

Both this and all the former build no nest; but lay their eggs either in the crevices of rocks, or in holes under ground near the shore. They chiefly choose the latter situation; for the puffin, the auk, the guillemot, and the rest, cannot easily rise to the nest when in a lofty situation. Many are the attempts these birds are seen to make to fly up to those nests which are so high above the surface. In rendering them inaccessible to mankind, they often render them almost inaccessible to themselves. They are frequently obliged to make three or four efforts, before they can come at the place of incubation. For this reason, the auk and guillemot, when they have once laid their single egg, which is extremely large for the size, seldom forsake it until it is excluded. The male, who is better furnished for flight, feeds the female during this interval; and so bare is the place where she sits, that the egg would often roll down from the rock, did not the body of the bird support it.

But the puffin seldom chooses these inaccessible and troublesome heights for its situation. Relying on its courage and the strength of its bill, with which it bites most terribly, it either makes or finds a hole in the ground, where to lay and bring forth its young. All the winter these birds, like the rest, are ab-

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not web-footed, but the toes are enlarged as in the coots. They live on lakes and ponds, and build in the rushes. Their plumage, which changes much with age, is used frequently by furriers. The following cut represents the *Crested Grebe.*



This is one of the largest of the genus, and is an indigenous species, breeding annually on the pools amidst the fens, on the moors of Shropshire and Cheshire, and on a few of the northern Scottish lakes. During the winter, when the waters of the interior of the country are frozen, it retires to the mouths of rivers, and to the line of sea-coast, where it obtains the necessary supply of fish and small crustaceous animals, which constitute its principal food. Being upwards of three years in acquiring maturity, or at least the full development of the frieze that surrounds the neck and the occipital tufts, it is much more frequently met with in the young or imperfect state of plumage, than in that of the adult; and out of more than a dozen specimens, which have at different times come under my observation, not one had attained the distinguishing characters of the Crested Grebe. In this immature state it was long supposed to be a distinct species, and as such was known by the name of the *Tippet Grebe*, adopted from the use to which the soft and silky plumage of the lower parts of the body was often applied. When swimming, it moves very rapidly, and, from the flatness of its body, exhibits little more than the head and neck above the water. It dives with remarkable quickness, and is able to avoid the shot from a fowling-piece fired by flint and steel, though it cannot so easily escape from the sudden inflammation of the percussion-lock. Its progress when below the surface, which (as in other diving birds) is performed by an action of the wings somewhat similar to that of flying, is so speedy, as frequently to baffle the pursuit of a well-managed boat, and a stretch of 200 yards is sometimes made, before it rises again to breathe; and this act of respiration, before the bird becomes fatigued by continued pursuit, is commonly effected by merely raising the head above water. It rarely flies, according to Temminck, even making its migrations by swimming, which, however, cannot always be the case, as it is sometimes found on isolated pieces of water, where it could not arrive unless by the use of its wings; and these, though short, are not comparatively smaller than in some other species that are known to fly occasionally. Upon the continental parts of Europe it is abundant, particularly in Holland and certain districts of Germany. It is also known in America, and is mentioned in the Fauna Americæ Borealis, as having been killed by Dr Richardson upon the *Saskatshewan*.—It breeds in the fresh water, amidst reeds and other rank herbage, and the nest, which is very large and floats on the surface, is composed of a mass of decayed vegetable roots, flags, stems of water-lily, &c. The eggs, three or four in number, are of a greenish-white, in size rather bigger than those of a Teal. The young, when first excluded, are clothed in a parti-coloured down of reddish-brown and grayish-white, and are assiduously attended by the

sent; visiting regions too remote for discovery. At the latter end of March, or the beginning of April, come over a troop of their spies or harbingers, that stay two or three days, as it were to view and search out for their former situations, and see whether all be well. This done, they once more depart; and about the beginning of May, return again with the whole army of their companions. But if the season happens to be stormy and tempestuous, and the sea troubled, the unfortunate voyagers undergo incredible hardships: and they are found, by hundreds, cast away upon the shores, lean and perished with famine.[1] It is most probable, therefore, that this voyage is performed more on the water than in the air; and as they cannot fish in stormy weather, their strength is exhausted before they can arrive at their wished-for harbour.

The puffin, when it prepares for breeding, which always happens a few days after its arrival, begins to scrape up a hole in the ground not far from the shore; and when it has some way penetrated the earth, it then throws itself upon its back, and with bill and claws thus burrows inward, till it has dug a hole with several windings and turnings, from eight to ten feet deep. It particularly seeks to dig under a stone, where it expects the greatest security. In this fortified retreat it lays one egg; which though the bird be not much bigger than a pigeon, is of the size of a hen's.

When the young one is excluded, the parent's industry and courage is incredible. Few birds or beasts will venture to attack them in their retreats. When the great sea-raven, as Jacobson informs us, comes to take away their young, the puffins boldly oppose him. Their meeting affords a most singular combat. As soon as the raven approaches, the puffin catches him under the throat with its beak, and sticks its claws into its breast, which makes the raven, with a loud screaming, attempt to get away; but the little bird still holds fast to the invader, nor lets him go till they both come to the sea, where they drop down together, and the raven is drowned; yet the raven is but too often successful; and, invading the puffin at the bottom of its hole, devours both the parent and its family.

But were a punishment to be inflicted for immorality in irrational animals, the puffin is justly a sufferer from invasion, as it is often itself one of the most terrible invaders. Near the isle of Anglesey, in an islet called *Priesholm*, their flocks may be compared, for multitude, to swarms of bees. In another islet, called *the Calf of Man*, a bird of this kind, but of a different species, is seen in great abundance. In both places, numbers of rabbits are found to breed; but the puffin, unwilling to be at the trouble of making a hole, when there is one ready made, dispossesses the rabbits, and it is not unlikely destroys their young. It is in these unjustly acquired retreats that the young puffins are found in great numbers, and become a very valuable acquisition to the natives of the place. The old ones (I am now speaking of the Manks puffin) early in the morning, at break of day, leave their nests and young, and even the island, nor do they return till night-fall. All this time they are diligently employed in fishing for their young; so that their retreats on land, which in the morning were loud and clamorous, are now still and quiet, with not a wing stirring till the approach of dusk, when their screams once more announce their return. Whatever fish, or other food, they have procured in the day, by night begins to suffer a kind of half digestion, and is reduced to an oily matter, which is ejected from the stomach of the old ones into the mouth of the young. By this they are nourished, and become fat to an amazing degree. When they are arrived to their full growth, they who are intrusted by the lord of the island, draw them from their holes; and, that they may more readily keep an account of the number they take, cut off one foot as a token. Their flesh is said to be excessively rank, as they feed upon fish, especially sprats, and sea-weed; however, when they are pickled and preserved with spices, they are admired by those who are fond of high eating. We are told, that formerly their flesh was allowed by the church on Lenten days. They were, at that time, also taken by ferrets, as we do rabbits. At present, they are either dug out, or drawn out, from their burrows, with a hooked stick. They bite extremely hard, and keep such fast hold of whatsoever they seize upon, as not to be easily disengaged. Their noise, when taken, is very disagreeable, being like the efforts of a dumb person attempting to speak.

The constant depredation which these birds annually suffer, does not in the least seem to intimidate them, or drive them away; on the contrary, as the people say, the nest must be robbed or the old ones will breed there no longer. All birds of this kind lay but one egg; yet if that be taken away, they will lay another, and so on to a third; which seems to imply, that robbing their nests does not much intimidate them from laying again. Those, however, whose nests have been thus destroyed, are often too late in bringing up their young; who, if they be not fledged and pre-

parent, who procures food for them, and, according to Pennant, has often been observed to feed them with small eels. For Horned Grebe, see Plate XX. fig. 18.

[1] Willoughby's Ornith. p. 326.

pared for migration when all the rest depart, are left at land to shift for themselves. In August the whole tribe is seen to take leave of their summer residence; nor are they observed any more till the return of the ensuing spring. It is probable that they sail away to more southern regions, as our mariners frequently see myriads of water-fowl upon their return, and steering usually to the north. Indeed the coldest countries seem to be their most favoured retreats; and the number of water-fowl is much greater in those colder climates than in the warmer regions near the line. The quantity of oil which abounds in their bodies, serves as a defence against cold, and preserves them in vigour against its severity; but the same provision of oil is rather detrimental in warm countries, as it turns rancid, and many of them die of disorders which arise from its putrefaction. In general, however, water-fowl can be properly said to be of no climate; the element upon which they live being their proper residence. They necessarily spend a few months of summer upon land, to bring up their young; but the rest of their time is probably consumed in their migrations, or near some unknown coasts, where their provision of fish is found in greatest abundance.

Before I go to the third general division of water-fowls, it may not be improper to observe, that there is one species of round-billed water-fowl that does not properly lie within any of the former distributions. This is the Gooseander;[1] a bird with the body and wings shaped like those of the penguin kind, but with legs not hid in the belly. It may be distinguished from all others by its bill, which is round, hooked at the point, and toothed, both upper and under chap, like a saw. Its colours are various and beautiful; however, its manners and appetites entirely resemble those of the diver. It feeds upon fish, for which it dives; and is said to build its nest upon trees, like the heron and the cormorant. It seems to form the shade between the penguin and the goose kind; having a round bill like the one; and unembarrassed legs, like the other. In the shape of the head, neck, and body, it resembles them both.

CHAP. IX.

OF BIRDS OF THE GOOSE KIND, PROPERLY SO CALLED.

The Swan, the Goose, and the Duck, are leaders of a numerous, useful, and beautiful tribe of birds, that we have reclaimed from a state of nature, and have taught to live in dependence about us. To describe any of these, would be as superfluous as definitions usually are when given of things with which we are already well acquainted. There are

[1] This is the largest of the Auk kind, weighing about four pounds. It seldom makes its appearance in the



more southern districts of the country, except in winters attended by long continued frost; but in the northern parts of Scotland, and in the Orkneys and other Scottish islands, it is a permanent resident; finding subsistence throughout the year either in the fresh-water lakes of the interior, or (when these are frozen) in the deep indentations of the coast, formed by the saline lochs, so numerous in that part of the kingdom. It is widely distributed throughout the arctic regions of both the ancient and new worlds. In Europe, during its equatorial migration, it visits France, Holland, Germany, and even more southern countries; and Wilson mentions it as a well known winter visitant upon the coasts, lakes, and rivers of the United States. During the summer the great body of these birds retires to high latitudes, for the purpose of reproduction; and at that time they are found in Iceland, Greenland, and other northern parts of Europe. In Asia, they visit Siberia, Kamtschatka, &c., and in America, during the above period, they are distributed through the fur countries of that vast continent. The nest is constructed (near to the edge of the water) of a mass of grass, roots, and other materials, mixed and lined with down. It is placed sometimes among stones or other *debris*, and sometimes in the long grass, or under the cover of bushes, and (when the locality affords them) in the stumps or hollows of decayed trees. The eggs are from twelve to fourteen in number, of a cream-yellow colour; and their form is a long oval, both ends being equally obtuse.

The gooseander, except when on wing, is almost always seen upon the water, being unable to make any great progress on land, in consequence of the backward position of the legs, and the slight degree of freedom that the tibiæ possess from their situation within the integuments of the abdomen. Its activity, however, in the former element, makes ample amends for this deficiency. In swimming, the body, from its broad and flattened shape, is deeply sunk in the water, having the head, neck, and back only visible. It is an excellent diver, with the power of remaining for a long time submerged, and making its way with great rapidity beneath the surface. In this manner its food is obtained, consisting entirely of fish; and which, when once seized, are securely held in its serrated bill. It rises with difficulty, or at least with much apparent exertion, from the surface of the water, but when once fairly on wing, its flight is not only swift, but can be sustained for a considerable time. By earlier writers, the females and young males (which resemble that sex for upwards of a year) were considered and described as a distinct species.

few that have not had opportunities of seeing them, and whose ideas would not anticipate our description. But, though nothing be so easy as to distinguish these in general from each other, yet the largest of the duck kind approach the goose so nearly, that it may be proper to mark the distinctions.

The marks of the goose are, a bigger body, large wings, a longer neck, a white ring above the rump, a bill thicker at the base, slenderer towards the tip, with shorter legs placed more forward on the body. They both have a waddling walk; but the duck from the position of its legs, has it in a greater degree. By these marks, these similar tribes may be known asunder; and though the duck should be found to equal the goose in size, which sometimes happens, yet there are still other sufficient distinctions.

But they all agree in many particulars; and have a nearer affinity to each other than the neighbouring kinds in any other department. Their having been tamed has produced alterations in each, by which they differ as much from the wild ones of their respective kinds, as they do among themselves. There is nearly as much difference between the wild and the tame duck, as between some sorts of the duck and the goose; but still the characteristics of the kind are strongly marked and obvious; and this tribe can never be mistaken.

The bill is the first great obvious distinction of the goose kind from all of the feathered tribe. In other birds, it is round and wedge-like, or crooked at the end. In all the goose-kind it is flat and broad, made for the purpose of skimming ponds and lakes of the mantling weeds that stand on the surface. The bills of other birds are made of a horny substance throughout; these have their inoffensive bills sheathed with a skin which covers them all over. The bill of every other bird seems, in some measure, formed for piercing or tearing; theirs are only fitted for shovelling up their food, which is chiefly of the vegetable kind.

Though these birds do not reject animal food when offered them, yet they can contentedly subsist upon vegetables, and seldom seek any other. They are easily provided for; wherever there is water, there seems to be plenty. All the other web-footed tribes are continually voracious, continually preying. These lead more harmless lives: the weeds on the surface of the water, or the insects at the bottom, the grass by the bank, or the fruits and corn in cultivated grounds, are sufficient to satisfy their easy appetites; yet these, like every other animal, will not reject flesh, if properly prepared for them; it is sufficient praise to them that they do not eagerly pursue it.

As their food is chiefly vegetables, so their fecundity is in proportion. We have had frequent opportunities to observe, that all the predatory tribes, whether of birds or quadrupeds, are barren and unfruitful. We have seen the lion with its two cubs; the eagle with the same number; and the penguin with even but one. Nature that has supplied them with powers of destruction, has denied them fertility. But it is otherwise with these harmless animals I am describing. They seem formed to fill up the chasms in animated nature, caused by the voraciousness of others. They breed in great abundance, and lead their young to the pool the instant they are excluded.

As their food is simple, so their flesh is nourishing and wholesome. The swan was considered as a high delicacy among the ancients; the goose was abstained from as totally indigestible. Modern manners have inverted tastes; the goose is now become the favourite; and the swan is seldom brought to table, unless for the purpose of ostentation. But at all times the flesh of the duck was in high esteem; the ancients thought even more highly of it than we do. We are contented to eat it as a delicacy; they also considered it as a medicine; and Plutarch assures us, that Cato kept his whole family in health, by feeding them with duck whenever they threatened to be out of order.

These qualities, of great fecundity, easy sustenance, and wholesome nourishment, have been found so considerable as to induce man to take these birds from a state of nature, and render them domestic. How long they have been thus dependents upon his pleasure is not known; for, from the earliest accounts, they were considered as familiars about him. The time must have been very remote; for there have been many changes wrought in their colours, their figures, and even their internal parts, by human cultivation. The different kinds of these birds, in a wild state, are simple in their colourings; when one has seen a wild goose or a duck, a description of its plumage will, to a feather, exactly correspond with that of any other. But in the tame kinds, no two of any species are exactly alike. Different in their size, their colours, and frequently in their general form, they seem the mere creatures of art; and having been so long dependent upon man for support, they seem to assume forms entirely suited to his pleasures or necessities.

CHAP. X.

OF THE SWAN, TAME AND WILD.[1]

No bird makes a more indifferent figure upon land, or a more beautiful one in the water, than the swan. When it ascends from its favourite element, its motions are awkward, and its neck is stretched forward with an air of stupidity; but when it is seen smoothly sailing along the water, commanding a thousand graceful attitudes, moving at pleasure without the smallest effort; "when it proudly

[1] The extensive family of Swimming Birds to which these noble ornaments of our rivers and lakes belong, are at once characterized by their straight broad bills, clothed with a continuation of the common epidermis instead of the usual horny covering, and armed at the edges with a regular series of laminated teeth. Their wings are of moderate length; their legs short; and their feet divided into four toes, the three anterior united throughout by a palmated expansion, and the posterior perfectly distinct from the rest. They are for the most part inhabitants of fresh water rather than of the sea; and subsist more upon vegetable than animal substances.

In the Linnean system of classification the great majority of these birds were referred to a single genus, under the generic name of Anas, derived originally from the common duck, and extended from it to the whole of its tribe. But the vast number of species thus brought together, and the consequent difficulty of determining any unknown bird that might be referable to the group, long since suggested the expediency of its dismemberment, and the formation of smaller and more manageable subdivisions. Many naturalists, from Ray down to the present time, have attempted, with more or less success, to simplify by these means the study of the most interesting family among our water-fowl; but several of the divisions that have been established among them rest upon such apparently trivial characters, that we are by no means prepared to adopt them in their fullest extent. There are some, however, such as the swans, the geese, and the ducks, so strikingly distinguished, as to have been separated, in popular nomenclature, from the earliest times; and this separation being confirmed by tangible characters, we cannot hesitate to consider it as founded upon just and sufficient principles.

Of the characters by which the swans are distinguished from the rest of the family, the most remarkable are the extreme length of their necks; the oval shape of their nostrils, which are placed about the middle of their bill; the nakedness of their cheeks; the equal breadth of their bills throughout; the great depth of that organ at the base, where the vertical considerably exceeds the transverse diameter; and the position of their legs behind the centre of gravity. They are by far the largest species of the family; and there are very few birds that exceed them in magnitude. They live almost constantly upon the water, preferring the larger streams and open lakes; and feed chiefly upon aquatic plants, the roots of which they are enabled to reach by means of their long necks, for they rarely if ever plunge the whole of their bodies beneath the surface. They also devour frogs and insects, and occasionally, it is said, even fishes; but this last assertion is contradicted by almost every observer who has attended particularly to their habits, and seems quite at variance with the fact that the fish-ponds to which they are sometimes confined do not appear to suffer the smallest diminution in the number of their inhabitants from the presence of these inoffensive birds. We are moreover informed by Mr Yarrell that he has never found in the stomachs of any of the numerous individuals dissected by him the least vestige of such a diet. In their habits they are as peaceable as they are majestic in form, elegant in attitude, graceful in their motions, and, in the two species that are most commonly known to us, unsullied in the purity of their white and glossy plumage.

Of these species that which is known, improperly with reference to a large proportion of the individuals that compose it, as the tame swan, is probably the most common, being found in a state of domestication throughout the greater part of the northern hemisphere. In a wild state it is met with in almost every country of Europe, especially towards the east, and is particularly abundant in Siberia. Its distinguishing characters are found chiefly in its bill, which is throughout of an orange red, with the exception of the edges of the mandibles, the slight hook at the extremity, the nostrils, and the naked spaces extending from the base towards the eyes, all of which are black. A large protuberance, also of a deep black, surmounts the base of the bill; the iris is brown; and the legs black, with a tinge of red. All the plumage, without exception, in the adult bird, is of the purest white. In length the full grown male measures upwards of five feet, and more than eight in the expanse of its wings, which reach, when closed, along two-thirds of the tail. Its weight is usually about twenty pounds, but it sometimes attains five and twenty or even thirty; and those which inhabit the southern coast of the Caspian are said to reach a still more enormous size. The female is rather smaller than the male; her bill is surmounted by a smaller protuberance; and her neck is somewhat more slender. When first hatched the young are of a dusky gray, with lead-coloured bill and legs; in the second year their plumage becomes lighter, and their bill and legs assume a yellowish tinge; in the third year they put on the adult plumage and colouring of the naked parts.

The wild birds of this species, like most of the water-fowl, are migratory in their habits. In the temperate regions of Europe they begin to absent themselves in October, and return towards the end of March to the quarters which they occupied in the preceding year. But when the winter is not particularly severe, they frequently remain through it, seeking for shelter among the dams and sluices of the rivers, and returning to their former quarters at the breaking of the frost. To protect the tame birds from the severity of the season, it is usual to drive them into the same houses with the ducks and geese; but in such strict confinement they entirely lose their spirits, become melancholy and diseased, and are constantly making attempts to escape. It is much better, whenever it is possible, both with them and with the commoner species of water-fowl, to leave them at liberty upon a piece of water, which, if their number is at all considerable, they will always keep open by their continual motion, without any risk of freezing their feet. Swans kept in this manner during the winter are generally in much better condition at the return of spring than those which have been confined to the house.

The females choose for their nesting-place the least frequented situations on the banks of the rivers or lakes which they inhabit, and build their nests in the rudest manner of twigs and reeds, lined with a comfortable coating of their breast feathers. They lay six or eight grayish eggs, and sit for five weeks, generally in April and May. As soon as the young birds are hatched, they are carried by both parents to the water, and for

rows in state," as Milton has it, "with arched neck, between its white wings mantling," there is not a more beautiful figure in all nature. In the exhibition of its form, there are no broken or harsh lines, no constrained or catching motions; but the roundest contours, and the easiest transitions; the eye wanders over every part with insatiable plea-

two or three weeks afterwards are borne upon their backs, or placed for shelter and warmth beneath their wings. The attentions of the parent birds are continued until the next pairing season, when the old males drive the young from their society, and compel them to shift for themselves. To prevent the tame ones from flying away, it is necessary every year to clip their quill-feathers; and this mutilation seems to deprive them not only of the power, but also of the desire, to regain their liberty. They accustom themselves with ease to the society of man, and seem even to become attached to him, probably in consequence of the kindness with which they are every where treated, and the peculiar privileges which they enjoy at his hands. Besides their natural food, consisting of plants, insects, snails, and similar productions, they eagerly devour bread and all kinds of grain, and in winter are chiefly kept upon these substances and the same kind of provender that is given to ducks and geese.

Although naturally one of the most gentle and inoffensive of birds, the large size and great muscular power of the Swan render it a formidable enemy when driven to extremity, and compelled to act on the defensive. In such a case it is said to give battle to the eagle, and frequently even to repel his attack, forcing him to seek his safety in flight. It never attempts to molest any of the smaller water-fowl that inhabit its domains; but in the season of its amours it will not suffer a rival to approach its retreat without a sanguinary struggle, in which one or other is generally destroyed. It is said to attain a very great age, thirty years being commonly spoken of as the term of its existence. It is even asserted that in Alkmar, a town in the north of Holland, there died, in the year 1672, a swan belonging to the municipality, which bore on its collar the date of 1573, and must consequently have been a century old; and several other instances of a similar nature have been related by authors. We must confess, however, that we entertain strong doubts of the authenticity of such statements, founded merely on popular tradition and unsupported by any positive evidence.

The *Wild Swan*.—The wild swan, or, as it is not unfrequently termed, the hooper, is a native of nearly the whole northern hemisphere. In the old world it passes northwards as far as Iceland and Kamtschatka, skirting the borders of the arctic circle, but rarely entering within its limits. Those which inhabit Europe generally pass the winter in its more southern regions, and even extend their flight to Egypt and Barbary; while the Asiatic birds seem rarely to pass much farther south than the shores of the Caspian and Black seas. In America the range of their migrations is bounded by Hudson's bay on the north, and Louisiana and the Carolinas on the south. They are extremely abundant in the northern parts of the new continent and in Siberia; and in many districts of Russia they take the place of that which is improperly termed the tame species, submitting themselves with equal readiness to the process of domestication.

The external differences between these two swans are not at first sight very obvious; but, trivial as they appear, they are uniform and constant. The bill of the present species is entirely destitute of protuberance at its base, and its colours are in a great degree reversed, the black occupying the point and nearly the whole of the bill, its base alone and the spaces extending from it beneath the eyes being of a bright yellow. The legs are black or dusky; the iris brown; and the entire plumage, as in the other species, pure white, but with an occasional tinge of yellowish gray. The young pass through similar gradations of colour with those of the tame swan, and arrive, like them, at their perfect plumage about the third or fourth year.

Slight as are these outward differences, they are fully sufficient for the detection of the species; and the separation founded upon them receives ample confirmation from anatomical characters of the highest importance. Not to speak of the difference in the number of their ribs, which are twelve in the wild swan and eleven only in the tame, their tracheæ or windpipes afford unquestionable evidence of their distinctness. This organ, which, in the tame swan, passes directly from the neck into the cavity of the chest without forming any previous convolution, enters in the wild species an appropriate cavity in the keel of the breast-bone, within which it passes to a considerable depth, then returns upwards, and is again inflected over the edge of the sternum before plunging into the chest. Ray was the first to point out this marked distinction between the two birds, which had previously been regarded as doubtful species. It was neglected, however, by later naturalists, and even Buffon and Linnæus were inclined to consider them as mere varieties; but in these days, when the importance of anatomical characters is fully recognised, they are universally allowed to be distinct.

So essential indeed is this character that we have no hesitation in admitting a third species, lately described by Mr Yarrel, as equally distinct from the hooper and the tame swan, although inhabiting the same localities as the former and apparently by no means of unfrequent occurrence. This bird, which had been entirely overlooked by all systematic ornithologists, is about one third less than the common wild swan; but its trachea, of smaller comparative calibre, passes still more deeply into the cavity of the sternum, at the extremity of which, quitting the keel, it takes a horizontal direction, and occupies the posterior flattened portion of the bone. The bronchi or subdivisions of the windpipe are less than half the length of the same parts in the common hooper. Outwardly the differences between the two birds are even less strongly marked than those which distinguish the wild and tame swans from each other; consisting principally in the deep orange colour of the base of the bill, which is confined to a more limited space than the yellow on the same part in the hooper, and does not advance upon the sides; and in the number of the quill-feathers of the tail, which are eighteen in the new species and twenty in the old. To this fine addition to our list of native birds Mr Yarrell has applied the name of Bewick's swan, (see a representation of it in Plate XIX. fig. 25.) in commemoration of an artist whose labours have done more to render the study of ornithology popular in this country than the works of any writer that could be named.

The *Black Swan*.—When the classical writers of antiquity spoke of the black swan as a proverbial rarity, so improbable as almost to be deemed impossible, little did they imagine that in these latter days a region would be discovered, nearly equal in extent to the Roman empire even at the proudest period of its greatness, in which their "rara avis" would be found in as great abundance as the common wild swan upon the lakes of Europe. Such, however, has been one of the least singular among the many strange and unexpected results of the discovery of the great southern continent of Australia. Scarcely a traveller who has visited its shores

sure, and every part takes a new grace with a new motion.

This fine bird has long been rendered domestic; and it is now a doubt whether there be any of the tame kind in a state of nature. The wild swan, though so strongly resembling this in colour and form, is yet a different bird; for it is very differently formed within. The wild swan is less than the tame by almost a fourth; for as the one weighs twenty pounds, the other only weighs sixteen pounds and three quarters. The colour of the tame swan is all over white; that of the wild bird, is along the back and the tips of the wings, of an ash-colour. But these are slight differences compared to what are found upon dissection. In the tame swan, the windpipe sinks down into the lungs in the ordinary manner; but in the wild, after a strange and wonderful contortion, like what we have seen in the crane, it enters through a hole formed in the breast-bone; and being reflected therein, returns by the same aperture; and being contracted into a narrow compass by a broad and bony cartilage, it is divided into two branches, which, before they enter the lungs, are dilated, and, as it were, swollen out into two cavities.

Such is the extraordinary difference between these two animals, which externally seem to be of one species. Whether it is in the power of long-continued captivity and domestication to produce this strange variety, between birds otherwise the same, I will not take upon me to determine. But certain it is, that our tame swan is no where to be found, at least in Europe, in a state of nature.

As it is not easy to account for this difference of conformation, so it is still more difficult to reconcile the accounts of the ancients with the experience of the moderns, concerning the vocal powers of this bird. The tame swan is one of the most silent of all birds; and the wild one has a note extremely loud and disagreeable. It is probable, the convolutions of the wind-pipe may contribute to increase the clangour of it; for such is the harshness of its voice, that the bird from thence has been called the hooper. In neither is there the smallest degree of melody; nor have they, for above this century, been said to give specimens of the smallest musical abilities; yet, notwithstanding this, it was the general opinion of antiquity, that the swan was the most melodious bird; and that even to its death, its voice went on improving. It would show no learning to produce what they have said upon the music of the swan: it has already been collected by Aldrovandus; and still more professedly by the Abbe Gedoyn, in the Transactions of the Academy of Belles Lettres. From these accounts, it appears that, while Plato, Aristotle, and Diodorus Siculus, believed the vocality of the swan, Pliny and Virgil seem to doubt that received opinion. In this equipoise of authority, Aldrovandus seems to have determined in favour of the Greek philosophers; and the form of the windpipe in the wild swan, so much resembling a musical instrument, inclined his belief still more strongly. In aid of this also, came the testimony of Pendasius, who affirmed, that he had often heard swans sweetly singing in the lake of Mantua, as he was rowed up and down in a boat; as also of Olaus Wormius, who professed that many of his friends and scholars had heard them singing. "There was," says he, "in my family, a very honest young man, John Rostorph, a student in di-

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omits to mention this remarkable bird. An early notice of its transmission to Europe occurs in a letter from



Witsen to Dr Martin Lister, printed in the twentieth volume of the Philosophical Transactions; and Valentyn published in 1726 an account of two living specimens brought to Batavia. Cook, Vancouver, Philip, and White, mention it incidentally in their Voyages; and Labillardiere, in his narrative of the expedition of D'Entrecasteaux in search of La Perouse, has given a more particular description, together with a tolerable figure. Another figure, of no great value, has also been given by Dr Shaw in his Zoological Miscellany. Since this period many living individuals have been brought to England, where they thrive equally well with the Emeus, the Kanguroos, and other Australian animals, insomuch that they can now scarcely be regarded as rarities even in this country. They are precisely similar in form and somewhat inferior in size to the wild and tame swans of the old world; but are perfectly black in every part of their plumage, with the exception of the primary and a few of the secondary quill-feathers, which are white. Their bill is of a bright red above, and is surmounted at the base in the male by a slight protuberance, which is wanting in the female. Towards its anterior part it is crossed by a whitish band. The under part of the bill is of a grayish white; and the legs and feet are of a dull ash-colour. In every other respect, except in the mode of convolution of its trachea, this bird perfectly corresponds with its well known congeners. The black swans are found as well in Van Dieman's Land as in New South Wales and on the western coast of New Holland. They are generally seen in flocks of eight or nine together, floating on a lake; and when disturbed, flying off like wild geese in a direct line one after the other. They are said to be extremely shy, so as to render it difficult to approach within gunshot of them.—*Gardens and Menagerie of the Zoological Society illustrated, Vol. II.*

vinity, and a Norwegian by nation. This man did, upon his credit, and with the interposition of an oath, solemnly affirm, that once in the territory of Dronten, as he was standing on the sea-shore, early in the morning, he heard an unusual and sweet murmur, composed of the most pleasant whistlings and sounds; he knew not at first whence they came, or how they were made, for he saw no man near to produce them; but looking round about him, and climbing to the top of a certain promontory, he there espied an infinite number of swans gathered together in a bay, and making the most delightful harmony; a sweeter in all his life-time he had never heard." These were accounts sufficient at least to keep opinion in suspense, though in contradiction to our own experience; but Aldrovandus, to put, as he supposed, the question past all doubt, gives us the testimony of a countryman of our own, from whom he had the relation. This honest man's name was Mr Geo. Braun, who assured him, that nothing was more common in England than to hear swans sing; that they were bred in great numbers in the sea near London; and that every fleet of ships that returned from their voyages from distant countries, were met by swans, that came joyfully out to welcome their return, and salute them with a loud and cheerful singing! It was in this manner that Aldrovandus, that great and good man, was frequently imposed upon by the designing and the needy: his unbounded curiosity drew round him people of every kind, and his generosity was as ready to reward falsehood as truth.—Poor Aldrovandus! after having spent a vast fortune for the purposes of enlightening mankind; after having collected more truth, and more falsehood, than any man ever did before him, he little thought of being reduced at last to want bread, to feel the ingratitude of his country, and to die a beggar in a public hospital!

Thus it appears that our modern authorities, in favour of the singing of swans, are rather suspicious, since they are reduced to this Mr G. Braun, and John Rostorph, the native of a country remarkable for ignorance and credulity. It is probable the ancients had some mythological meaning in ascribing melody to the swan; and as for the moderns, they scarcely deserve our regard. The swan, therefore, must be content with that share of fame which it possesses on the score of its beauty; since the melody of its voice, without better testimony, will scarcely be admitted by even the credulous.

This beautiful bird is as delicate in its appetites, as elegant in its form. Its chief food, is corn, bread, herbs growing in the water, and roots and seeds, which are found near the margin. It prepares a nest in some retired part of the bank, and chiefly where there is an islet in the stream. This is composed of water-plants, long grass, and sticks; and the male and female assist in forming it with great assiduity. The swan lays seven or eight eggs, white, much larger than those of a goose, with a hard, and sometimes a tuberous, shell. It sits near two months before its young are excluded; which are ash-coloured when they first leave the shell, and for some months after. It is not a little dangerous to approach the old ones when their little family are feeding round them. Their fears as well their pride, seem to take the alarm; and they have sometimes been known to give a blow with their pinion, that has broke a man's leg or arm.

It is not till they are a twelvemonth old that the young swans change their colour with their plumage. All the stages of this bird's approach to maturity are slow, and seem to mark its longevity. It is two months hatching; a year in growing to its proper size: and if, according to Pliny's observation, those animals that are longest in the womb are the longest lived, the swan is the longest in the shell of any bird we know, and is said to be remarkable for its longevity. Some say that it lives three hundred years; and Willoughby, who is in general diffident enough, seems to believe the report. A goose, as he justly observes, has been known to live a hundred; and the swan, from its superior size, and from its harder, firmer flesh, may naturally be supposed to live still longer.

Swans were formerly held in such great esteem, in England, that by an act of Edward the Fourth none, except the son of the king, was permitted to keep a swan, unless possessed of five marks a year. By a subsequent act, the punishment for taking their eggs was imprisonment for a year and a day, and a fine at the king's will. At present, they are but little valued for the delicacy of their flesh; but many are still preserved for their beauty. We see multitudes on the Thames and Trent; but no where greater numbers than on the salt water inlet of the sea, near Abbotsbury, in Dorsetshire.

CHAP. XI.

OF THE GOOSE, AND ITS VARIETIES.[1]

The Goose, in its domestic state, exhibits a variety of colours. The wild goose always

[1] From the concurrent testimony of our old writers, (says Mr Selby) it appears that this species was formerly

retains the same marks; the whole upper part is ash-coloured; the breast and belly are of a dirty white; the bill is narrow at the base, and at the tip it is black; the legs are of a saffron colour, and the claws black. These marks are seldom found in the tame; whose bill is entirely red, and whose legs are entirely brown. The wild goose is rather less than the tame; but both invariably retain a white ring round their tail, which shows

very abundant in Britain; and was also a permanent resident here, breeding annually in great numbers in the



fens of Lincolnshire, and some of the adjoining counties. The draining and cultivation of these marshy tracts, under progressive agricultural improvement, and the increasing population of the kingdom, has, however, banished these birds from their ancient haunts; and they are now, comparatively speaking, of rare occurrence, and, as far as I can ascertain, only met with in small flocks during the winter. They seem to have given place, as it were, to the Bean Goose which, as a winter visitant, is very numerous, and widely spread throughout the country. According to Temminck, the present species seldom advances much beyond the fifty-third degree of north latitude; its geographical distribution extending over the central and eastern parts of Europe, Northern Asia, and some parts of Western Africa, where it inhabits the marshes, and the borders of lakes and inland seas. It breeds amongst the rushes and other coarse herbage, making a large nest of vegetable matter, and laying from six to twelve eggs of a sullied white. Its food consists principally of the various grasses of the moist and marshy tracts it affects, though it eats grain with avidity. It is also very fond of the tender blades of wheat, &c., and often, during its periodical visits, does considerable damage to corn fields in an early stage of growth. Being a bird of great shyness and vigilance, it can only be approached by stealth, and with the utmost caution; this is generally effected by that mode of fowling called *stalking*, in which a horse is so trained, as, hiding the person of the fowler, to advance by degrees, and in an easy and natural manner, upon the flock, as they are at rest or feeding on the ground. In the latter state, which only occurs during the daytime, sentinels (occasionally relieved) are always on the watch to give notice of approaching danger, which they do, on the slightest suspicion, by a cry of alarm; and immediately the whole flock take wing, with an alertness and rapidity that could scarcely be expected in birds of such bulky appearance. At night they generally retire to the water for repose, but the same watchful attention to safety is maintained by sentinels, that distinguishes their conduct during the day. They usually fly at a great height in the air, moving either in a single diagonal line, or in two lines forming an angle, or inverted V. In this order the office of leader is taken by turns, the foremost, when fatigued, retiring to the rear, and allowing the next in station to lead the flight. It is generally admitted that our race of domestic geese has originally sprung from this species, and however altered they may now appear in bulk, colour, or habits, the essential characters remain the same; no disinclination to breed with each other is evinced between them, and the offspring of wild and domesticated birds are as prolifi as their mutual parents.

The Bean, or as it is very frequently called, the *wild* goose, bears in general appearance, and in the colour of its plumage, a great resemblance to the preceding species, and with which it is sometimes confounded. It may, however, be always distinguished from the ray lag by the form of its bill, which is comparatively much smaller, shorter, and more compressed towards the end. The colour of that member also differs, the basal part of the under mandible, and that of the upper as far as the line of the nostrils, with the nails of both mandibles, being black, and the intermediate part flesh-red, inclining to orange. It is also generally less. In Britain it is well known as a regular winter visitant, arriving in large bodies from its northern summer haunts, during September or the beginning of October, and seldom taking its final departure before the end of April or beginning of May. The various flocks, during their residence in this country, have each their particular haunts or feeding districts, to which on each ensuing season they invariably return, as I have found to be the case in Northumberland and the southern parts of Scotland, where wild geese have been known to frequent certain localities for a continued series of years. The habits of this and the preceding species are very similar, and they show the same vigilance, and use the same means of guarding against surprise: their capture is therefore proportionably difficult, and it is only by stratagem that, when at rest on the ground or feeding, they can be approached within gun-shot. In stormy weather, when they are compelled to fly lower than they usually do, they may be sometimes intercepted from a hedge or bank, situated in the route they are observed to take early in the morning, in passing to their feeding ground. At night they retire to the water, or else to some ridge or bar of sand on the sea coast, sufficiently distant from the main land to afford a secure retreat; and where the approach of an enemy must become visible, or at least audible to their acute organs, before it could endanger their safety. The haunts or feeding grounds of these birds are more frequently in the higher districts than in the lower and marshy tracts of the country, and they give the preference to open land, or where the inclosures are very large. They feed much upon the tender wheat, sometimes injuring these fields to a great extent; and they frequent also the stubbles, particularly such as are laid down with clover and other grasses. In the early part of spring they often alight upon the newly sown bean and pea fields, picking up greedily such of the pulse as is left on the surface; and I am inclined to think that their trivial name has been acquired from their apparent predilection for this kind of food, rather than from the shape and aspect of the nail of the upper mandible, to which it has been generally attributed. They usually fly at a considerable elevation, either in a diagonal line, or in two such lines, opposed to each other, and forming a leading acute angle, like the other species; and when on wing they maintain a loud cackling, in which the voices of the two sexes may be easily distinguished. The rate at which they move, when favoured by a gentle breeze, is seldom less than from forty to fifty miles an hour, a velocity which enables them to have their roosting place far removed from the district they frequent by day. The principal breeding stations, or summer retreats, of the bean goose are in countries within the arctic circle; it is said, however, that great numbers

that they are both descended from the same original.

The wild goose is supposed to breed in the northern parts of Europe; and, in the beginning of winter, to descend into more temperate regions. They are often seen flying at very great heights, in flocks from fifty to a hundred, and seldom resting by day. Their cry is frequently heard when they are at an imperceptible distance above us; and this seems bandied from one to the other, as among hounds in the pursuit. Whether this be the note of mutual encouragement, or the necessary consequence of respiration, is doubtful; but they seldom exert it when they alight in these journeys.

Upon their coming to the ground by day, they range themselves in a line, like cranes; and seem rather to have descended for rest, than for other refreshment. When they have sat in this manner for an hour or two, I have heard one of them, with a loud long note, sound a kind of charge, to which the rest punctually attended, and they pursued their journey with renewed alacrity. Their flight is very regularly arranged; they either go in a line abreast, or in two lines, joining in an angle in the middle. I doubt whether the form of their flight be thus arranged to cut the air with greater ease, as is commonly believed; I am more apt to think it is to present a smaller mark to fowlers from below. A bullet might easily reach them if huddled together in a flock, and the same discharge might destroy several at once; but, by their manner of flying, no shot from below can affect above one of them; and from the height at which they fly this is not easy to be hit.

The Barnacle differs, in some respects, from both these; being less than either, with a black bill, much shorter than either of the preceding. It is scarcely necessary to combat the idle error of this bird's being bred from a shell sticking to ships' bottoms; it is well known to be hatched from an egg in the ordinary manner, and to differ in very few particulars from all the rest of its kind.

The Brent goose is still less than the former, and not bigger than a Muscovy duck, except that the body is longer. The head, neck, and upper part of the breast, are black; but about the middle of the neck, on each side, are two small spots or lines of white, which together appear like a ring.

These, and many other varieties, are found in this kind, which agree in one common character of feeding upon vegetables, and being remarkable for their fecundity.[1] Of

breed annually in Harris, and some of the other outermost Western islands. The nest is made in the marshy grounds, and formed of grasses and other dry vegetable materials; the eggs are white, and from eight to twelve in number. Among the other winter visitants to this island, are the *White-fronted Goose*, the *Barnacle Goose*, the *Brent Goose*, and the *Red-breasted Goose*.

[1] The *Canadian Goose*, (see Plate XIX. fig. 26.) The Canadian goose is somewhat larger than our common domesticated breed. It is also slenderer in its make and especially in its neck, which consequently approaches more nearly to that of the swan. The entire length of the bird is about three feet, and the expanse of its wings rather more than five. The back and wing-coverts are of a dull brown, with a whitish tip to each of the feathers; the quill-feathers of the wings and tail black; the sides pale ashy brown; and the upper part of the head and neck black, with a broad patch of white spreading from the throat on either side over the lower part of the cheeks. By this latter character, which is extremely obvious, this species may at all times be readily distinguished. Its bill is black; its iris dark hazel; and its legs and feet grayish-black, or lead-coloured. There is little or no distinction in plumage between the two sexes. Although commonly known by the name of Canada geese, these birds are by no means confined to that country, but extend their migrations from the lowest latitudes of the United States to the highest parallels that have yet been visited in the northern regions of America. Throughout the whole of this vast extent of territory they are familiarly known as the harbingers of spring when passing to the north, and the presage of approaching winter on their return. In the United States it is the popular belief that their journeys are bounded by the great chain of lakes, in the islands of which they are supposed to breed; but even on the shores of Hudson's bay they are still found to be proceeding northwards, and they rarely nest further south than 60 deg. Captain Phipps mentions having seen wild geese at Spitzbergen, in more than 80 deg. of latitude; and Wilson deems it "highly probable that they extend their migrations under the very pole itself, amid the silent desolation of unknown countries, shut out since the creation from the prying eye of man by everlasting and insuperable bars of ice."

The passage of the geese to the north commences with the breaking up of the ice, their first appearance in Canada and on the shores of Hudson's bay varying with the forwardness of the spring, from the middle of April to the latter end of May. Their flight is heavy and laborious, but moderately swift, in a straight line when their number is but few, but more frequently in two lines meeting in a point in front. The van is said to be always led by an old gander, in whose wake the others instinctively follow. But should his sagacity fail in discovering the land-marks by which they usually steer, as sometimes happens in foggy weather, the whole flock appear in the greatest distress, and fly about in an irregular manner, making a great clamour. In their flights they cross indiscriminately over land or water, differing in this respect from several other geese, which prefer making a circuit by water to traversing the land. They also pass far inland, instead of confining their course to the neighbourhood of the sea. So important is the arrival of the geese to the inhabitants of these northern regions that the month in which they first make their appearance is termed by the Indians, as we are informed by Pennant, the goose moon. In fact not only the Indians, but the English settlers also, depend greatly upon these birds for their subsistence, and many thousands of them are annually killed, a large proportion of which are salted and barrelled for winter consumption. Many too that are killed on their return, after the commencement of the frost, are suffered to freeze, and are thus kept as fresh provision for several months. Others, either taken young or wounded, are frequently detained

these, however, the tame goose is the most fruitful.—Having less to fear from its enemies, leading a securer and a more plentiful life, its prolific powers increase in proportion to its ease; and though the wild goose seldom lays above eight eggs, the tame goose is often seen to lay above twenty. The female hatches her eggs with great assiduity; while the gander visits her twice or thrice a day, and sometimes drives her off to take her place, where he sits with great state and composure.

But beyond that of all animals is his pride when the young are excluded: he seems then to consider himself as a champion, not only obliged to defend his young, but also to keep off the suspicion of danger; he pursues dogs and men that never attempt to molest him: and, though the most harmless thing alive, is then the most petulant and provoking. When, in this manner, he has pursued the calf or the mastiff, to whose contempt alone he is indebted for safety, he returns to his female and her brood in triumph, clapping his wings, screaming, and showing all the marks of conscious superiority. It is probable, however, these arts succeed in raising his importance among the tribe where they are displayed; and it is probable there is not a more respectable animal on earth to a goose than a gander!

A young goose is generally reckoned very good eating; yet the feathers of this bird still farther increase its value. I feel my obligations to this animal every word I write; for, however deficient a man's head may be, his pen is nimble enough upon every occasion: it is happy indeed for us that it requires no great effort to put it in motion. But the feathers of this bird are still as valuable in another capacity, as they make the softest and the warmest beds to sleep on.

Of goose-feathers most of our beds in Europe are composed; in the countries bordering on the Levant, and in all Asia, the use of them is utterly unknown. There they use mattresses, stuffed with wool, or camel's hair, or cotton; and the warmth of their climate may perhaps make them dispense with cushions of a softer kind. But how it happens that the ancients had not the use of feather-beds is to me surprising: Pliny tells us, indeed, that they made bolsters of feathers to lay their heads on; and this serves as a proof that they turned feathers to no other uses.

As feathers are a very valuable commodity, great numbers of geese are kept tame in the fens in Lincolnshire, which are plucked once or twice a year. These make a considerable article of commerce. The feathers of Somersetshire are most in esteem; those of Ireland are reckoned the worst. Hudson's bay also furnishes very fine feathers, supposed to be of the goose kind. The down of the swan is brought from Dantzic. The same place also sends us great quantities of the feathers of the cock and hen; but Greenland, Iceland, and Norway, furnish the best feathers of all: and in this number we may reckon the Eider down, of which we shall take notice in its place. The best method of curing feathers is to lay them in a room, in an open exposure to the sun; and when dried, to put them into bags, and beat them well with poles to get the dust off. But, after all, nothing will prevent, for a time, the heavy smell which arises from the putrefaction of the oil contained in every feather; no exposure will draw this off, how long so ever it be continued; they must be lain upon, which is the only remedy; and for this reason old feathers are much more valuable than new.

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in captivity during the winter. They seldom breed in so low a latitude as Churchhill river; but Hearne states that he has occasionally met with their eggs in that neighbourhood. The females rarely lay more than four eggs, but the whole number is generally hatched. They are said usually to select an island in preference to the mainland, for the performance of the maternal office in greater safety.

The *Spur-winged Goose.*—Another species of the same group, is the Gambo or spur-winged goose, a native of northern, and more particularly of western, Africa. This bird agrees with the Canadian goose in some of those characters which connect the geese with the swans, but is much more robust in make and more anserine in general appearance. Its size and proportions are nearly those of the common goose; its legs long and placed beneath the middle of the body; and its neck of moderate length and proportionate thickness. At the base of the bill, which is broad and flat, it has a tubercle like that of the tame swan, increasing in size with the age of the individual; and the bend of its wings is furnished with a large blunt spur, which appears to be occasionally doubled. The spur-winged goose was confounded by Willoughby, and afterwards by Buffon, with a variety of the Egyptian goose, equally distinguished by the presence of a spur upon the wing, but differing considerably in the form of its bill, and in its colours. In the former the entire bill and the tubercle at its base are of a dull red; the sides of the head are white; the upper parts of the body black, with a metallic brilliancy; a patch of white, mottled with black spots occupies the base of each of the wings; and the under parts are white, sometimes marked with indistinct zigzag lines of gray. The legs have an obscure tinge of red; and the spurs of the wings are horn-coloured; but the latter are visible only when the wings are expanded, being concealed at all other times beneath the plumage. —*Gardens and Menageries of the Zoological Gardens Illustrated, Vol II.*

CHAP. XII.

OF THE DUCK, AND ITS VARIETIES.

The Tame Duck is the most easily reared of all our domestic animals. The very instincts of the young ones direct them to their favourite element; and though they are conducted by a hen, yet they despise the admonitions of their leader.

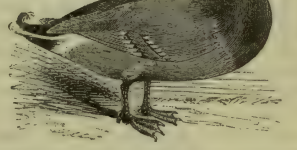
This serves as an incontestable proof that all birds have their manners rather from nature than education. A falcon pursues the partridge, not because it is taught by the old one, but because its appetites make their importunate call for animal food: the cuckoo follows a very different trade from that which its nurse endeavoured to teach it; and, if we may credit Pliny, in time destroys its instructor: animals of the duck kind also follow their appetites, not their tutor, and come to all their various perfections without any guide. All the arts possessed by man are the result of accumulated experience; all the arts of inferior animals are self-taught, and scarcely one acquired by imitation.

It is usual with the good women to lay duck-eggs under a hen, because she hatches them better than the original parent would have done.[1] The duck seems to be a heedless inattentive mother; she frequently leaves her eggs till they spoil, and even seems to forget that she is intrusted with the charge: she is equally regardless of them when excluded; she leads them to the pond, and thinks she has sufficiently provided for her offspring when she has shown them the water. Whatever advantages may be procured by coming nearer the house, or attending in the yard, she declines them all; and often lets the vermin, who haunt the waters, destroy them, rather than bring them to take shelter nearer home. The hen is a nurse of a very opposite character: she broods with the utmost assiduity, and generally brings forth a young one from every egg committed to her charge; she does not lead her younglings to the water indeed, but she watchfully guards them when there, by standing at the brink. Should the rat, or the weasel, attempt to seize them, the hen can give them protection; she leads them to the house when tired with paddling, and rears up the supposititious brood, without ever suspecting that they belong to another.

The wild duck[2] differs, in many respects, from the tame; and in them there is still greater variety than among the domestic kinds. Of the tame duck there are not less

[1] The rearing of ducks is made an object of great importance in China. The greater part of them are hatched by artificial warmth; the eggs being laid in boxes of sand, are placed on a brick hearth, to which a proper degree of heat is given during the time required for hatching. The ducklings are fed with crawfish and crabs, boiled and cut small, and afterwards mixed with boiled rice; and in about a fortnight they are able to shift for themselves. The Chinese then provide them with an old step-mother, who leads them where they are to find provender, being first put on board a "sampane" or boat, which is destined for their habitation, and from which the whole flock, often 300 or 400 in number, go out to feed, and return at command. This method is used nine months out of the twelve, for in the colder months it does not succeed; and is so far from a novelty that it may be seen everywhere, more especially about the time of cutting the rice, when the masters of the duck-boats row up and down the rivers, according to the opportunity of procuring food, which during that season is found in plenty, at the ebb of the tide, on the rice plantations, which are overflowed at high water. It is curious to see how the ducks obey their master; for some thousands belonging to different boats will feed at large on the same spot, and on a signal given, follow the leader to their respective boats, without a stranger being found among them.

[2] The *Wild Duck* or *Mallard* is nearly two feet in length, two feet ten inches in extent of wing, and



weighs from two and a half to three pounds. The bill is of a greenish yellow colour; the head and upper part of the neck are of a glossy changeable green, terminated in the middle of the neck by a white collar, with which it is nearly encircled. The scapulars are white, barred or rather undulated with minute lines of brown; the back is brown, and the rump black, glossed with green. On the wing coverts two transverse white streaks edged with black enclose a broad stripe of a lucid violet-green colour. The lower part of the neck and breast is of a chestnut-colour; the belly is pale gray, crossed with numerous transverse dusky lines. The tail consists of twenty feathers and is pointed in shape; the four middle are of a greenish black colour and curve upward in a remarkable manner; the others as usual of a gray brown, margined with white. Legs orange. The female is very plain. The bill is shorter and smaller than that of the male; and the ground colour of the plumage is pale reddish brown, speckled with black. The violet-green stripe on the wings is as in those of the male; but none of the tail feathers are curved. The young male birds, previously to their first moult, resemble rather the female than the male parent. In a domestic state some individuals appear in nearly the same plumage as the wild ones; others vary greatly from them as well as from each other, and are marked with nearly every colour; but all the males, or drakes, still retain the curled feathers of the tail. The tame duck is, however, of a more dull and less elegant form and appearance than the wild, domestication having deprived it of its lofty gait, long tapering neck, and sprightly eyes.

than ten different sorts; and of the wild, Brisson reckons above twenty. The most obvious distinction between wild and tame ducks is in the colour of their feet: those of the tame duck being yellow, those of the wild duck black. The difference between wild ducks among each other, arises as well from their size as the nature of the place they feed

Wild ducks inhabit Europe, Asia, and America, in summer frequenting the lakes and marshes of the north, and in autumn migrating southward in large bodies, and spreading themselves over the lakes and marshes of more temperate latitudes. Considerable numbers of them return northward in spring; but many straggling pairs, as well as former colonists, stay in this country to rear their young, which become natives, and remain throughout the year in the marshy tracts of the British isles. Large flocks visit Egypt in November after the inundation of the Nile. In an opposite direction of the globe, the lakes in the Orkneys form one of their great resorts in winter; and when the lakes happen to be frozen, they betake themselves to the shores of the islands. In these districts they may be seen in great multitudes, and on the report of a gun they rise like clouds. They are also known to abound on the lake of Zirknitz in Carniola, where they are often swallowed entire by the huge pikes which frequent that remarkable piece of water. On the approach of a storm they issue from the caverns in the rocks, and fly about the country, where they are soon captured by the peasants; many of them are killed with clubs at the very openings of the cavities, being dazzled by the light of day. In England they abound most in the fens of Lincolnshire, where prodigious numbers are annually taken in the decoys.

Wild ducks are naturally very shy birds, and fly at a considerable height in the air, in the form of a wedge or triangle. Before they alight on any spot, they describe several turns round it, as if to reconnoitre it, and then descend with great precaution. They generally keep at a distance from the shore when they swim; and when the greater part of them sleep upon the water, with their heads under their wings, some of the party are always awake to watch over the common safety, and to apprize the sleepers of the approach of danger. The extreme wariness of these birds renders much patience and ingenuity necessary on the part of the fowler. They rise vertically from the water with loud cries; and in the night-time their flight over head may be known by the hissing noise which they make. They are more active by night than by day; indeed those that are seen by day have, in general, been roused either by a sportsman or by some bird of prey.

Wild ducks breed only once in the year, the pairing-time commencing about the end of February or beginning of March, and lasting three weeks, during which period each couple lives apart, concealed among the reeds and bushes during the greater part of the day. The female generally selects a thick tuft of bushes, insulated in a pool or lake, for her breeding station, and binds, cuts, and arranges the bushes in the form of a nest; sometimes she makes her nest on heaths at some distance from the water, scraping together a heap of the nearest vegetables for the purpose:—a rick of straw in the fields occasionally serves her purpose. Latham says, that she has even been known to lay her eggs in a high tree, in the deserted nest of a magpie or crow; and he records an instance of one that was found at Etchingham, in Sussex, sitting upon nine eggs, in an oak, at the height of twenty-five feet from the ground, the eggs being supported by some small twigs placed crosswise. The female, during the incubation, usually plucks the down from her breast to line her nest, in which she frequently deposits sixteen eggs, which she generally covers when she leaves the nest for the purpose of feeding. Whenever she returns to it, she alights at some distance, and approaches it by winding paths; but when she has resumed her seat she is not easily induced to quit it. The male keeps watch near the nest, or accompanies and protects his mate in her temporary excursions in quest of food. All the young are hatched in one day, and on the following the mother leads them to the water; or if the nest be high, or at a distance from water, both parents convey them, one by one, in their bills or between their legs, and they are no sooner consigned to the water than they begin to swim about with the greatest ease, and to feed on insects. The mother-bird is a most attentive and watchful parent until her young progeny are able to fly: this is in about three months after their birth, and in three months more they attain to their full size and plumage.

The flesh of the wild duck is more delicate and juicy, and of a finer flavour, than that of the domestic. It is almost every where in high estimation as an article of food, and hence the ingenuity of man, in all the countries which it frequents, has been employed in devising stratagems for the capture of this most cautious and wily bird. We shall now proceed to furnish our readers with an account of some of the more remarkable of these stratagems. Some of the methods of capturing the wild ducks in America, as described by Wilson in his "American Ornithology," are among the most singular resorted to in any country, and claim to be noticed in this place.

In some ponds frequented by these birds, five or six wooden figures, cut and painted so as to represent ducks, and sunk, by pieces of lead nailed to their bottoms so as to float at the usual depth on the surface, are anchored in a favourable position for being raked from a concealment of brushwood, &c., on shore. The appearance of these decoys usually attracts passing flocks, which alight and are shot down. Sometimes eight or ten of these painted ducks are fixed in a frame in various swimming postures, and secured to the bow of the gunner's skiff, projecting before it in such a manner that the weight of the frame sinks the figures to their proper depth; the skiff is then dressed with sedge or coarse grass, in an artful manner, as low as the water's edge; and under cover of this, which appears like a covey of ducks swimming by a small island, the gunner floats down sometimes to the very skirts of a whole congregated multitude, and pours in a destructive and repeated fire of shot among them. In winter, when detached pieces of ice are occasionally floating in the river, some of the fowlers on the Delaware paint their whole skiff or canoe white, and laying themselves flat at the bottom, with their hand over the side silently managing a small paddle, direct it imperceptibly into or near a flock, before the ducks have distinguished it from a floating mass of ice, and generally do great execution amongst them. A whole flock has sometimes been thus surprised asleep with their heads under their wings. On land, another stratagem is sometimes practised with great success:—a large tight hogshead is sunk in the flat marsh or mud, near the place where ducks are accustomed to feed at low water, and where, otherwise, there is no shelter. The edges and top are artfully concealed with tufts of long coarse grass and reeds, or sedge. From within this the fowler, unseen and unsuspected, watches the collecting party, and, when a sufficient number offers, sweeps them down with great effect.

Of the method of capturing wild ducks in the fens of Lincolnshire, a particular description will be found in the text, towards the close of the present chapter. See

in. Sea-ducks, which feed in salt-water, and dive much, have a broad bill, bending upwards, a large hind toe, and a long blunt tail. Pond-ducks, which feed in plashes, have a straight and narrow bill, a small hind-toe, and a sharp-pointed train. The former are called, by our decoy-men, *foreign ducks*: the latter are supposed to be natives of England. It would be tedious to enter into the minute varieties of such a number of birds; all agreeing in the same general figure, the same habits and mode of living, and differing in little more than their size and the colours of their plumage. In this tribe we may rank, as natives of our own European dominions, the Eider Duck,[1] which is double the size of a common duck, with a black bill; the Velvet Duck, not so large, and with a yellow bill; the Scoter, with a knob at the base of a yellow bill; the Tufted Duck, adorned with a thick crest; the Scaup Duck, (see Plate XX. fig. 13.) less than the common duck, with the bill of a grayish blue colour; the Golden Eye, (see Plate XIX. fig. 34.) with a large white spot at the corners of the mouth, resembling an eye; the Sheldrake, with the bill of a bright red, and swelling into a knob; the Mallard, which is the stock from whence our tame breed has probably been produced; the Pintail, with the two middle feathers of the tail three inches longer than the rest; the Pochard, with the head and neck of a bright

also Nos. 183 and 184 of "Penny Magazine," to which we are indebted for the above Note.

[1] In Britain the range of this valuable species extends to about the 55th degree of north latitude, to the southward of which it becomes of very rare occurrence. Its limits, however, towards the pole are scarcely ascertained, as it has been found, I believe, in the highest latitudes yet penetrated by navigators. In Iceland, Spitzbergen, and other arctic regions of Europe, it is very abundant; and in those cold countries is highly beneficial to the inhabitants, on account of its feathers, elastic down, eggs, &c. It is equally common in parallel latitudes of the North American continent, and, in fact, may be considered a general inhabitant of the Frigid zone. Upon the Northumbrian coast many eiders breed upon the group of Fern islands, situated towards the northern extremity of that county, and from two to eight miles distant from the shore, and which, with Coquet island (about ten miles farther along the coast,) may be reckoned the most southern breeding-stations of these birds. About April they are seen assembling in small groups along the shores of the mainland, from whence they cross over to the islands in May, soon after which the females begin to prepare their nests, and they usually commence laying about the twentieth of that month. The males, as soon as this takes place, and incubation commences, leave the females, and again spread themselves along the shore, in companies of four or five together, and do not (as far as my observation goes) "continue on watch near the shore, as long as the females remain sitting," and then desert both her and the newly hatched brood, as mentioned in Shaw's Zoology. The usual number of eggs is five, of a pale asparagus-green colour, of an oblong shape, and not much less than those of a goose. The nest is composed of dried grasses, mixed with a quantity of the smaller algæ, and as incubation proceeds (and which lasts for a month) a lining of down, plucked by the bird from her own body, is added. This addition is made daily, and at last becomes so considerable in mass, as to envelope and entirely conceal the eggs, contributing, perhaps by its effect, as a nonconductor of heat, to the perfect developement of the fœtus, and serving also as a protection from gulls and other enemies. The young, as soon as hatched, are conducted to the water, which in some instances must be effected by the parent conveying them in her bill, as I have often seen the nest in such situations as to preclude the possibility of their arriving at it in any other way; and indeed, the keeper of one of the lighthouses (upon the impending rock close to which an eider duck, for many seasons, had her nest, and hatched her young) assured me, that he had seen the bird engaged in this interesting duty. The down of the eider is remarkably light and elastic, not more so perhaps than that of its congener the *King Eider*, the Scoter, and some others of the oceanic Anatidæ; but as it is procured in greater quantity from this species, the whole imported from Iceland and other northern countries (though mixed with that of several others) is still sold under the denomination of *Eider down*. From the nest of two or three of these birds, I have frequently procured as much down as would fill a middling-sized pillow, though the same, when compressed, was not above two handfuls, and did not weigh above an ounce. As plucked from the living bird, it is much more elastic than when taken from the body after death, —a fact confirmative of what I have formerly advanced, viz. that the plumage is not mere inert matter, as believed by Montagu and others, but is endowed with a kind of living principle, and influenced by the state and condition of the bird. In Iceland, Greenland, &c. where the eider down forms a great branch of their commerce, and where the birds breed in great numbers near to each other, the natives wait anxiously for the event. The first production of eggs, together with the down, is taken from them, but the next they are allowed to incubate, and rear the young, though a part of the down is from time to time removed, the female continuing to supply it as long as any remains upon the lower part of her body.—The food of the eider consists of various species of shell-fish, crustaceous animals, and the roes of these and fishes. Such as I have dissected were generally filled with the triturated remains of mytili, tellineæ, &c.; and twice I found the subjects gorged with the spawn of fish. They dive for their food like the Scoters, remaining for a long time submerged, and often in water of six or eight fathoms deep. They also fly with great strength, and at the rate (as calculated) of more than ninety miles in the hour. When approached in a boat they generally take wing whilst beyond gun-shot, and when suddenly surprised they dive; but if actively pursued, and compelled to dive repeatedly, they may be so far tired out as at last to be incapable of submerging with sufficient quickness to prevent a fatal aim being taken. In this manner I have often succeeded in procuring specimens; and the same mode, it appears, is in use amongst the Greenlanders, who strike them with their darts as they rise fatigued to the surface after long-continued pursuit. The trachea of the male bird is of equal diameter throughout its length, and composed of hard and perfect rings, lined with a membrane. The lower larynx, or bone of divarication, is enlarged in front, and furnished on the left side with an elevated, flatly globose, bony protuberance, or labyrinth, about the size of a large nut. The bronchi are large, swelling much toward their middle, and composed of imperfect rings, united by a membrane. That on the left side, which proceeds from the tympanum, is of much larger diameter than the other, and both suddenly decrease when they enter the substance of the

bay; the Widgeon, (see Plate XX. fig. 36.) with a lead coloured bill, and the plumage of the back marked with narrow black and white undulated lines, but best known by its whistling sound; lastly, the Teal, which is the smallest of this kind, with the bill black, the head and upper part of the neck of a bright bay.—These are the most common birds of the duck kind among ourselves: but who can describe the amazing variety of this tribe if he extends his view to the different quarters of the world? The most noted of the foreign tribe are the Muscovy Duck, or, more properly speaking, the Musk Duck, so called from a supposed musky smell, with naked skin round the eyes, and which is a native of Africa; the Brazilian Duck, that is of the size of a goose, all over black except the tips of the wings; the American Wood Duck, with a variety of beautiful colours, and a plume of feathers that falls from the back of the head like a friar's cowl.—These, and twenty others, might be added, were increasing the number of names the way to enlarge the sphere of our comprehension.

All these live in the manner of our domestic ducks, keeping together in flocks in the winter, and flying in pairs in summer, bringing up their young by the water-side, and leading them to their food as soon as out of the shell. Their nests are usually built among heath or rushes, not far from the water, and they lay twelve, fourteen, or more eggs, before they sit: yet this is not always their method; the dangers they continually encounter from their ground situation, sometimes obliges them to change their manner of building; and their awkward nests are often seen exalted on the tops of trees. This must be a very great labour to perform, as the duck's bill is but ill formed for building a nest, and giving the materials of which it is composed a sufficient stability to stand the weather. The nest, whether high or low, is generally composed of singular materials. The longest grass mixed with heath, and lined with the bird's own feathers, usually go to the composition: however, in proportion as the climate is colder, the nest is more artificially made, and more warmly lined. In the Arctic regions, nothing can exceed the great care all of this kind take, to protect their eggs from the intenseness of the weather. While the gull and the penguin kind seem to disregard the severest cold, the duck, in those regions, forms itself a hole to lay in, shelters the approach, lines it with a layer of long grass and clay; within that another of moss; and, lastly, a warm coat of feathers, or down. The eider duck is particularly remarkable for the warmth of its nest. This bird, which, as was said, is above twice as large as the common duck, and resides in the colder climates, lays from six to eight eggs, making her nest among the rocks or the plants along the sea-shore. The external materials of the nest are such as are in common with the rest of the kind; but the inside lining, on which the eggs are immediately deposited, is at once the softest, warmest, and the lightest substance with which we are acquainted. This is no other than the inside down which covers the breast of the bird in the breeding season. This the female plucks off with her bill, and furnishes the inside of her nest with a tapestry more valuable than the most skilful artists can produce. The natives watch the place where she begins to build, and, suffering her to lay, take away both the eggs and the nest. The duck, however, not discouraged by the first disappointment, builds and lays in the same place a second time; and this they in the same manner take away: the third time she builds, but the drake must supply the down from his breast to line the nest with: and if this be robbed, they both forsake the place, and breed there no more. This down the natives take care to separate from the dirt and moss with which it is mixed: and though no people stand in more need of a warm covering than themselves, yet their necessities compel them to sell it to the more indolent and luxurious inhabitants of the south for brandy and tobacco.

As they possess the faculties of flying and swimming, so they are in general birds of passage, and, it is most probable, perform their journeys across the ocean, as well on the water as in the air. Those that migrate to this country, on the approach of winter, are seldom found so well-tasted or so fat as the fowls that continue with us the year round: their flesh is often lean, and still oftener fishy; which flavour it has probably contracted in the journey, as their food in the lakes of Lapland,

lungs. Several attempts have been made to domesticate the eider, but hitherto without much success; that it may be done with care and attention, I have no doubt, as I have twice succeeded in rearing these birds from the egg, and preserving them alive till upwards of twelve months; but as I had no appropriate place for them at the time, they fell victims to accident, being trodden upon by horses or cattle. Indeed, their sluggish nature, or rather their inactivity upon land, renders their escape from any sudden danger a matter of great difficulty. I know also other instances in which they have been reared from the egg to maturity. The eider drake is long in reaching the adult state, that plumage not being perfected before the fourth year. This would seem, analogically reasoning, to indicate a great longevity, as we find the eagle and some other birds that do not attain perfection till after two or three years, endowed with singular length of life. The flesh of this species in the natural state, from the kind of food they subsist on, is very unpalatable; but would probably, under a different diet, lose its rank and fishy flavour. (For King Eider, a variety of the Eider, see Plate XX. fig. 29.)—*Selby's British Ornithology, Vol. II.*

from whence they descend, is generally of the insect kind.

As soon as they arrive among us, they are generally seen flying in flocks to make a survey of those lakes where they intend to take up their residence for the winter. In the choice of these they have two objects in view; to be near their food, and yet remote from interruption. Their chief end is to choose some lake in the neighbourhood of a marsh, where there is at the same time a cover of woods, and where insects are found in great abundance. Lakes, therefore, with a marsh on one side, and a wood on the other, are seldom without vast quantities of wild-fowl; and where a couple are seen at any time, that is a sufficient inducement to bring hundreds of others. The ducks flying in the air, are often lured down from their heights by the loud voice of the mallard from below. Nature seems to have furnished this bird with very particular faculties for calling. The windpipe, where it begins to enter the lungs, opens into a kind of bony cavity, where the sound is reflected as in a musical instrument, and is heard a great way off. To this call all the stragglers resort; and in a week or a fortnight's time, a lake, that before was quite naked, is black with water-fowl that have left their Lapland retreats, to keep company with our ducks who never stirred from home.

They generally choose that part of the lake where they are inaccessible to the approach of the fowler, in which they all appear huddled together, extremely busy, and very loud. What it is can employ them all the day it is not easy to guess. There is no food for them at the place where they sit and cabal thus, as they choose the middle of the lake; and as for courtship, the season for that is not yet come; so that it is wonderful what can so busily keep them occupied. Not one of them seems a moment at rest. Now pursuing one another, now screaming, then all up at once, then down again; the whole seems one strange scene of bustle, with nothing to do.

They frequently go off in a more private manner by night to feed in the adjacent meadows and ditches, which they dare not venture to approach by day. In these nocturnal adventures they are often taken; for though a timorous bird, yet they are easily deceived, and every spring seems to succeed in taking them. But the greatest quantities are taken in decoys; which, though well known near London, are yet untried in the remoter parts of the country. The manner of making and managing a decoy is as follows:

A place is to be chosen for this purpose far remote from the common highway, and all noise of people. A decoy is best where there is a large pond surrounded by a wood, and beyond that a marshy and uncultivated country. When the place is chosen, the pool, if possible, is to be planted round with willows, unless a wood answers the purpose of shading it on every side. On the south and north side of this pool are two, three, or four ditches or channels, made broad towards the pool, and growing narrower till they end in a point. These channels are to be covered over with nets, supported by hooped sticks bending from one side to the other; so that they form a vault or arch growing narrower and narrower to the point, where it is terminated by a tunnel-net, like that in which fish are caught in weirs. Along the banks of these channels so netted over, which are called pipes, many hedges are made of reeds slanting to the edge of the channel, the acute angles to the side next the pool. The whole apparatus, also, is to be hidden from the pool by a hedge of reeds along the margin, behind which the fowler manages his operations. The place being fitted in this manner, the fowler is to provide himself with a number of wild ducks made tame, which are called decoys. These are always to be fed at the mouth or entrance of the pipe, and to be accustomed to come at a whistle.

As soon as the evening is set in, *the decoy rises*, as they term it, and the wild-fowl feed during the night. If the evening be still, the noise of their wings, during their flight, is heard at a very great distance, and produces no unpleasing sensation. The fowler, when he finds a fit opportunity, and sees his decoy covered with fowl, walks about the pool, and observes into what pipe the birds gathered in the pool may be enticed or driven. Then casting hemp-seed, or some such seed as will float on the surface of the water, at the entrance, and up along the pipe, he whistles to his decoy-ducks, who instantly obey the summons, and come to the entrance of the pipe, in hopes of being fed as usual. Thither also they are followed by a whole flock of wild ones, who little suspect the danger preparing against them. Their sense of smelling, however, is very exquisite; and they would soon discover their enemy, but that the fowler always keeps a piece of turf burning at his nose, against which he breathes, and this prevents the effluvia of his person from reaching their exquisite senses. The wild ducks, therefore, pursuing the decoy-ducks, are led into the broad mouth of the channel or pipe, nor have the least suspicion of the man, who keeps hidden behind one of the hedges. When they have got up the pipe, however, finding it grow more and more narrow, they begin to suspect danger, and would return back; but they are now prevented by the man, who shows himself at the broad end below. Thi-

ther, therefore, they dare not return; and rise they may not, as they are kept by the net above from ascending. The only way left them, therefore, is the narrow-funnelled net at the bottom; into this they fly, and there they are taken.

It often happens, however, that the wild fowl are in such a state of sleepiness or dozing, that they will not follow the decoy-ducks. Use is then generally made of a dog, who is taught his lesson. He passes backward and forward between the reed-hedges, in which there are little holes, both for the decoy-man to see, and for the little dog to pass through. This attracts the eye of the wild-fowl; who, prompted by curiosity, advance towards this little animal, while he all the time keeps playing among the reeds, nearer and nearer the funnel, till they follow him too far to recede. Sometimes the dog will not attract their attention till a red handkerchief, or something very singular, be put about him. The decoy-ducks never enter the funnel-net with the rest, being taught to dive under water as soon as the rest are driven in.

The general season for catching fowl in decoys is from the latter end of October till February. The taking them earlier is prohibited by an act of George the Second, which imposes a penalty of five shillings for every bird destroyed at any other season.

The Lincolnshire decoys are commonly let at a certain annual rent, from five pounds to twenty pounds a year; and some even amount to thirty. These principally contribute to supply the markets of London with wild-fowl. The number of ducks, widgeon, and teal, that are sent thither, is amazing. Above thirty thousand have been sent up in one season from ten decoys in the neighbourhood of Wainfleet. This quantity makes them so cheap on the spot, that it is asserted, that several decoy-men would be glad to contract for years to deliver their ducks at the next town for ten pence the couple.[1]

To this manner of taking the wild-fowl in England, I will subjoin another, still more extraordinary, frequently practised in China. Whenever the fowler sees a number of ducks settled in any particular plash of water, he sends off two or three gourds to float among them. These gourds resemble our pompions; but, being made hollow, they swim on the surface of the water; and on one pool there may sometimes be seen twenty or thirty of these gourds floating together. The fowl at first are a little shy of coming near them; but by degrees they come nearer, and as all birds at last grow familiar with a scare-crow, the ducks gather about these, and amuse themselves by whetting their bills against them. When the birds are as familiar with the gourds as the fowler could wish, he then prepares to deceive them in good earnest. He hollows out one of these gourds large enough to put his head in; and making holes to breathe and see through, he claps it on his head. Thus accoutred, he wades slowly into the water, keeping his body under, and nothing but his head in the gourd above the surface; and in that manner moves imperceptibly towards the fowls, who suspect no danger. At last, however, he fairly gets in among them; while they, having been long used to see gourds, take not the least fright while the enemy is in the very midst of them: and an insidious enemy he is; for ever as he approaches a fowl, he seizes it by the legs, and draws it in a jerk under water. There he fastens it under his girdle, and goes to the next, till he has thus loaded himself with as many as he can carry away. When he has got his quantity, without ever attempting to disturb the rest of the fowls on the pool, he slowly moves off again; and in this manner pays the flock three or four visits in a day. Of all the various artifices for catching fowl, this seems likely to be attended with the greatest success, as it is the most practised in China.

[1] They have now become comparatively rare.

CHAP. XIII.

OF THE KING-FISHER.[1]

I will conclude this history of birds with one that seems to unite in itself somewhat of every class preceding. It seems at once possessed of appetites for prey like the rapacious kinds, with an attachment to water like the birds of that element. It exhibits in its form the beautiful plumage of the peacock, the shadings of the humming-bird, the bill of the crane, and the short legs of the swallow. The bird I mean is the King-fisher, of which many extraordinary falsehoods have been propagated; and yet of which many extraordinary things remain to be said that are actually true.

The King-fisher is not much larger than a swallow; its shape is clumsy; the legs disproportionably small, and the bill disproportionably long: it is two inches from the base to the tip; the upper chap black, and the lower yellow: but the colours of this bird atone for its inelegant form; the crown of the head and the coverts of the wings are of a deep blackish green, spotted with

[1] There are now known forty-two species of king-fishers, and of some of these several varieties.

bright azure; the back and tail are of the most resplendent azure; the whole under-



side of the body is orange-coloured; a broad mark of the same passes from the bill beyond the eyes; beyond that is a large white spot: the tail is short, and consists of twelve feathers of a rich deep blue; the feet are of a reddish yellow, and the three joints of the outmost toe adhere to the middle toe, while the inner toe adheres only by one.

From the diminutive size, the slender short legs, and the beautiful colours of this bird, no person would be led to suppose it one of the most rapacious little animals that skims the deep. Yet it is for ever on the wing, and feeds on fish, which it takes in surprising quantities, when we consider its size and figure. It chiefly frequents the banks of rivers, and takes its prey after the manner of the osprey, balancing itself at a certain distance above the water for a considerable space, than darting into the deep, and seizing the fish with inevitable certainty. While it remains suspended in the air, in a bright day, the plumage exhibits a beautiful variety of the most dazzling and brilliant colours. It might have been this extraordinary beauty that has given rise to fable; for whenever there is any thing uncommon, fancy is always willing to increase the wonder.[1]

Of this bird it has been said, that she built her nest on the water, and thus, in a few days, hatched and produced her young. But, to be uninterrupted in this task, she was said to be possessed of a charm to allay the fury of the waves; and during this period the mariner might sail with the greatest security. The ancient poets are full of these fables; their historians are not exempt from them. Cicero has written a long poem in praise of the halcyon, of which there remain but two lines. Even the emperor Gordian has written a poem on this subject, of which we have nothing remaining. These fables have been adopted each by one of the earliest fathers of the church. "Behold," says St Ambrose, "the little bird, which in the midst of winter lays her eggs on the sand by the shore. From that moment the winds are hushed; the sea becomes smooth; and the calm continues for fourteen days. This is the time she requires; seven days to hatch, and seven days to foster her young. Their Creator has taught these little animals to make their nest in the midst of the most stormy season, only to manifest his kindness by granting them a lasting calm. The seamen are not ignorant of this blessing; they call this interval of fair weather their *halcyon days*; and they are particularly careful to seize the opportunity, as they then need fear no interruption." This, and a hundred other instances, might be given of the credulity of mankind with respect to this bird; they enter into speculations concerning the manner of her calming the deep, the formation of her nest, and her peculiar sagacity; at present we do not speculate because we know, with respect to our king-fisher, that most of the facts are false. It may be alleged, indeed, with some show of reason, that the halcyon of the ancients was a different bird from our king-fisher; it may be urged, that many birds, especially on the Indian ocean, build a floating nest upon the sea; but still the history of the ancient halcyon is clogged with endless fable; and it is but an indifferent method to vindicate falsehood, by showing that a part of the story is true.

The king-fisher with which we are acquainted at present, has none of those powers of allaying the storm, or building upon the waves; it is contented to make its nest on the banks of rivers, in such situations as not to be affected by the rising of the stream. When it has found a place for its purpose, it hollows out with its bill a hole about a yard deep; or if it finds the deserted hole of a rat, or one caused by the root of a tree decaying, it takes quiet possession. This hole it enlarges at the bottom to a good size; and lining it with the down of the willow, lays its eggs there without any further preparation.[2]

[1] Montague, in his Ornithological Dictionary, says, that they never suspend themselves on the wing, and dart on their prey, like the osprey; but that they sit patiently on a bough over the water, and when a small fish comes near the surface, they dart on it, and seize it with their bill. He never could observe the old birds with any thing in their bills, when they went in to feed their young: from which he concludes that they eject it from their stomachs for this purpose. Sticklebucks and minnows form the principal food of the king-fisher, but it will also eat fry or spawn, slugs, worms, and leeches.

[2] Belon, who found the king-fisher plentiful on the banks of the Hebrus, in Thrace, appears to have been the first author who correctly stated that it makes its nest by mining into the sand, and was somewhat fearful that he should not be credited because he contradicted the ancients. Up to the present time, however, more or less misrepresentation has been introduced into the descriptions of its burrow. Gesner furnished it with a soft bed of reed flowers; Goldsmith says it lines its hole with the down of the willow; and colonel Montague, half reverting to the ball of fish bones described by

Its nest, or rather hole, is very different from that described by the ancients, by whom it is said to be made in the shape of a long-necked gourd of the bones of the sea-needle. The bones, indeed, are found there in great quantities, as well as the scales of fishes; but these are the remains of the bird's food, and by no means brought there for the purposes of warmth or convenience. The king-fisher, as Bellonius says, feeds upon fish, but is incapable of digesting the bones and scales, which he throws up again, as eagles and owls are seen to do a part of their prey. These fill the bird's nest of course; and although they seem as if designedly placed there, are only a kind of nuisance.

In these holes, which, from the remains of fish brought there, are very fœtid, the king-fisher is often found with from five eggs to nine. There the female continues to hatch, even though disturbed; and though the nest be robbed, she will again return and lay there. "I have had one of those females brought me," says Reaumur, "which was taken from her nest about three leagues from my house. After admiring the beauty of her colours, I let her fly again, when the fond creature was instantly seen to return back to the nest where she had just before been made a captive. There, joining the male, she again began to lay, though it was for the third time, and though the season was very far advanced. At each time she had seven eggs. The older the nest is, the greater quantity of fish-bones and scales does it contain: these are disposed without any order; and sometimes take up a good deal of room."

The female begins to lay early in the season; and excludes her first brood about the beginning of April. The male, whose fidelity exceeds even that of the turtle, brings her large provisions of fish while she is thus employed; and she, contrary to most other birds, is found plump and fat at that season. The male, that used to twitter before this, now enters the nest as quietly and as privately as possible. The young ones are hatched at the expiration of twenty days; but are seen to differ as well in their size as in their beauty.

As the ancients have had their fables concerning this bird, so have the modern vulgar. It is an opinion generally received among them, that the flesh of the king-fisher will not corrupt, and that it will even banish all vermin. This has no better foundation than that which is said of its always pointing, when hung up dead with its breast to the north. The only truth which can be affirmed of this bird, when killed, is, that its flesh is utterly unfit to be eaten; while its beautiful plumage preserves its lustre longer than that of any other bird we know.

Having thus given a short history of birds, I own I cannot take leave of this most beautiful part of the creation without reluctance. These splendid inhabitants of the air possess all those qualities than can soothe the heart, and cheer the fancy,—the brightest colours, the roundest forms, the most active manners, and the sweetest music. In sending the imagination in pursuit of these, in following them to the chirping grove, the screaming precipice, or the glassy deep, the mind naturally lost the sense of its own situation, and attentive to their little sports, almost forgot the TASK of describing them. Innocently to

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Aristotle, tells us that at the end of the hole there is a kind of bedding formed of the bones of small fish and some other substances, evidently the castings of the parent birds, generally about half an inch thick, and mixed in with earth. He farther thinks there is every reason to suppose that both the male and the female come to this spot to eject the refuse of their food for some time before the latter begins to lay, and that they dry it by the heat of their bodies, as they are frequently known to continue in the hole for hours long before laying; and on this disgorged matter the female deposits and hatches her eggs. Belon's account is very similar. From the high authority of Montague, the latter description is now copied as authentic by every modern author, with the exception of Temminck, who says nothing on the subject, and Wilson, who says of his belted king-fisher, that "its nest is neither constructed of glue nor fish-bones." We are certain, says Mr Rennie, in his Architecture of Birds, that this contradiction of the general belief will apply equally to the king-fisher of England. In the bank of a stream at Lee, in Kent, we have been acquainted with one of these nests in the same hole for several successive summers, but so far from the pellets of fish-bones, ejected as is done by all birds of prey, being dried on purpose to form the nest, they are scattered about the floor of the hole in all directions, from its entrance to its termination, without the least order or working up with the earth, and are all moist and fetid. That the eggs may by accident be laid upon portions of these fish-bones, is highly probable, for the floor is so thickly strewed with them, that no vacant spot might be found; but they assuredly are not by design built into a nest. The hole is from two to four feet long, sloping upwards, and narrow at the entrance, but widening in the interior, in order perhaps, to give the birds room to turn; and for the same apparent reason the eggs are not placed at the extremity. We are somewhat doubtful whether it selects, as is said, the old hole of a water-rat to save itself trouble, the water-rat being the deadly enemy of its eggs and young; but it seems to indicate a dislike to the labour of digging, that it frequents the same hole for a series of years, and will not abandon it, though the nest be repeatedly plundered. The accumulation of cast bones in one of these old holes has perhaps given origin to the notion of the nest being formed of them.

Our own opportunities, continues Mr Rennie, of carefully studying the habits of this bird, lead us to remark, that it is not so very shy and solitary as it has been represented, for it has more than once allowed us to approach within a few yards of the bough on which it was perched. The necessity for obtaining its food from streams and shallow ponds causes this bird, however, to frequent secluded places. The belted kingfisher of America, is partial to mill-dams, in defiance of the clack of the hopper, because there he finds facilities in watching for fish.

amuse the imagination in this dream of life is wisdom; and nothing is useless that, by furnishing mental employment, keeps us for a while in oblivion of those stronger appetites that lead to evil. But every rank and state of mankind may find something to imitate in those delightful songsters, and we may not only employ the time, but mend our lives, by the contemplation. From their courage in defence of their young, and their assiduity in incubation, the coward may learn to be brave, and the rash to be patient. The inviolable attachment of some to their companions may give lessons of fidelity; and the connubial tenderness of others be a monitor to the incontinent. Even those that are tyrants by nature never spread capricious destruction; and, unlike man, never inflict a pain but when urged by necessity.

A

HISTORY OF FISHES.

BOOK I.

OF FISHES IN GENERAL.[1]

CHAP. I.

INTRODUCTION.

The ocean is the great receptacle of fishes. It has been thought, by some, that all fish are naturally of that salt element; and that they have mounted up into fresh water by some accidental migration. A few still swim up rivers to deposit their spawn; but of the great body of fishes, of which the size is enormous, and the shoals are endless, those all

[1] Fishes (says professsor Blumenbach, in his Manual of Natural History) are those animals which possess red cold blood, which moves by means of true *fins* (with bony or cartilaginous fibres,) and which breathe by true *gills* lying deep at each side of the neck; and not, as in the larvæ of frogs, &c., projecting beyond it. I say *true* gills and *true* fins, in order to distinguish them from organs to a certain degree analogous in young frogs, salamanders, &c.

These gills (*branchiæ*,) in fishes, almost perfectly supply the place of lungs. They are placed on each side behind the head, for the most part under one or more large semilunar plates, hence called *opercula branchialia*, and in most instances connected with the membrane of the gills, *membrana branchiostega*. The gills themselves are filled with innumerable very delicate vessels, and are mostly divided on each side into four layers, which somewhat resemble the beard of a quill, and which are attached at their bases to a corresponding number of little bones.

Respiration, which fishes are nearly as incapable of dispensing with as those animals which possess lungs, is in them effected by introducing the air, which the water holds in solution, through the mouth into the gills, and then expelling it again through the branchial, (*apertura branchialis*;) consequently not by inspiring and expiring through the same passages, as in those animals which possess lungs.

Not having lungs, it is evident that they cannot have any voice, although some, as Cottus *cataphractes*, Cobitis *fossilis*, &c., can make a noise.

The form of the body in fishes, in general, is infinitely more varied than in quadrupeds and birds. In most, however, the body has a vertical direction, *i. e.* is flattened at both sides, (*corpus compressum*); in some, on the contrary, as the rays, it is horizontal and extended laterally (*corpus depressum*) sive *plagioplateum*); in others, as the eel, &c., it is more rounded; in others, prismatic or quadrangular, &c. In all, the head and trunk are connected immediately, without being separated by a neck.

With only a few exceptions, fishes are covered with scales; in the osseous fishes the scales are real, are formed of a peculiar substance, and in different species present a great number of varieties in point of form, marks, and colours, which latter sometimes shine like gold and silver. On the other hand, the cartilaginous fishes, in general, are covered with several bone-like plates, hook-shaped prickles, &c. The scales are covered externally with a kind of slime, which appears to be in a great measure excreted from small cavities, which, in most fishes, are placed in a line along each side of the body.

The fins, the organs of motion in fishes, in which a very great power of reproduction has been remarked, consist of their bony or cartilaginous spines or rays, connected together by a particular membrane, fastened to a bone, and set in motion by certain muscles. They are called, according to their position, the upper dorsal fins; those at the side, behind the gills, pectoral fins; those on the belly in front of the anus, abdominal fins; those behind this opening, anal fins; and lastly, those on the tail, which always have a vertical direction, caudal fins. The flying-fish, as they are called, have very long and stiff pectoral fins, by means of which they can raise themselves above the surface of the water, and fly for a short time.

Another auxiliary in the motion of fishes, particularly in rising and sinking, is the swim-bladder, with which fresh-water fish in particular are supplied, and which communicates by a particular canal, (*ductus pneumaticus*) generally with the œsophagus, seldom with the stomach.

With regard to their place of abode, fishes in general are divided into sea-fish and fresh-water fish. Many can live for some time out of water, as the eel, Muræna, &c. Others in hot mineral springs.

Most fishes, especially those of the sea, are nocturnal animals, that is, they are active during the night, and in the day remain in a state of repose. Hence the inhabitants of islands and coasts, who live on fish, choose the night for catching them.

A great many species of fish change their place of abode at certain seasons of the year. Many sea-fish ascend the mouths of rivers and creeks to spawn; many, as the herring for instance, in the North Atlantic, make

keep to the sea, and would quickly expire in fresh water. In that extensive and undiscovered abode, millions reside, whose manners are a secret to us, and whose very form is unknown. The curiosity of mankind, indeed, has drawn some from their depths, and his wants many more; with the figure of these at least he is acquainted; but for their pursuits, migrations, societies, antipathies, pleasures, times of gestation, and manner of bringing forth, these are all hidden in the turbulent element that protects them.

The number of fish to which we have given names, and of the figure, at least, of which we know something, according to Linnæus, are above four hundred.[1] Thus to appearance, indeed, the history of fish is tolerably copious; but when we come to examine, it will be found that of the greatest part of these we know very little. Those qualities, singularities, or advantages, that render animals worth naming, still remain to be discovered. The history of fishes, therefore, has little in it entertaining: for our philosophers hitherto, instead of studying their nature, have been employed in increasing their catalogues; and the reader, instead of observations or facts, is presented with a long list of names, that disgust him with their barren superfluity. It must displease him to see the language of science increasing, while the science itself has nothing to repay the increasing tax laid upon his memory.

extensive migrations at certain seasons of the year in incalculable numbers between the coasts of the west of Europe, and north-east of America. Fishes are in great proportion carnivorous animals, and as they have no feet with which to hold their prey, are supplied with a variety of other contrivances for mastering it. Some have long fibrous threads (*cirri*) about the mouth, for the purpose of enticing other small marine animals, as with a bait, as in the stargazer, frog-fish, &c. Others, as the chætodon *rostratus*, have a kind of syringe with which they strike down the insects flying over the surface of the water; others, as the three sea-fish, the electric ray, the tetrodon *electricus*, and trichiurus *indicus*, and the two fresh-water fish, the electric eel and silurus *electricus*, possess a peculiar benumbing paralyzing power, &c.

As to the external senses of fishes, smelling must in many be very acute, from the distance at which they discover a bait. Their hearing, also, is good, and they have organs similar to those of the internal ear in other red-blooded animals. Above all, however, there are many peculiarities in their eyes, numerous membranes, parts not found elsewhere, &c. From the deficiency of correct observations, little can be said decidedly on their instincts, and other mental faculties. It is known, however, that many, trout for example, become very docile; and that others, as old carp, are very wary and cunning.

As to their sleep, probably most have a winter sleep, but only a very few a fixed daily sleep, as is said to be the case with the gold-fish.

Except the small number of viviparous fishes, such as the eel, the blennius *viviparous*, but very few actually copulate. In most instances, the female lays the unimpregnated eggs, the male coming afterwards and sprinkling them with his semen. Advantage of this circumstance has been taken in rural economy, young fish having been procured by the artificial mixture of the ova and semen of trout, &c. Among other peculiarities in the mode of generation in fishes, many, as the lamprey, possess the organs of both sexes in perfection: whilst in others, as the carp, anomalous instances of hermaphrodites are found.

The increase in the numbers of most fishes is wonderfully great, so that although the ova are in most instances proportionally much smaller than in any other class of animals, the ovaria of many are larger than the whole of the body. Thus, in the herring, there have been counted from 20,000 to 37,000 ova; in the carp, upwards of 200,000; in the tench, 383,000; in the flounder, upwards of a million.

In some cases, the young fish have not their perfect form when they escape from the egg; but must, as in the amphibia, undergo a kind of metamorphosis by which they obtain fins, &c.

In proportion to their size, fishes reach a very advanced age. Examples are known of carp, pike, &c., living 150 years. On the other hand, some small fishes, as the stickleback, live only a few years.

The utility of fishes to man is not very various; for the most part only as food, but in this respect of the utmost importance to a great part of the human race, who live only on this class of animals. Savage nations, as the Kamschatkadales, Brazilians, &c., possess the art of preparing fish in a great variety of ways, even as a kind of flour, bread, &c. With many, as the islanders of the Pacific ocean, fishing forms a principal occupation, and a serious kind of study with reference to the ingenious methods and instruments which they have invented. To a great part of the cultivated world, the taking of the herring, the cod, tunny, &c., is of still greater value. The oil of the shark, cod, and herring, is used for burning in lamps, &c. The inhabitants of the eastern coasts of the middle of Asia, clothe themselves with the tanned skin of the salmon.—Many parts of other fish are employed for purposes of art, as the scales of the bleak for making false pearls.—Shagreen is made from the skin of sharks and rays; isinglass from the sturgeon, &c.

Fishes of prey are the most noxious, particularly the shark in the ocean, and the pike in fresh water. Many fishes, at least in certain spots, are poisonous, and prove fatal when eaten. Such, in particular, are certain species of the genus tetrodon.

The systematic classification of fishes appears to stand in need of much improvement. In the mean time they are arranged in two principal divisions, viz:—

(A.) Cartilaginous fishes (Pisces *cartilaginei*), without true bones: and

(B.) Bony fishes (Pisces *spinosi*), having bones, fishes properly so called.

The cartilaginous fishes are divided into the following two Orders, which M. de Lacepede has established, according to the presence or absence of the covering of the gills (*operculum*), and has divided the genera which they include accordingly:—

Order I. *Chondropterygii*. Without an operculum.

II. *Branchiostegi*. With an operculum.

Linnæus has arranged the osseous, or true fishes, according to the character and position of the ventral fins: viz.

III. *Apodes*. Without ventral fins.

IV. *Jugulares*. Having the ventral in the front of the pectoral fins.

V. *Thoracici*. Having the ventral immediately below the pectoral fins.

VI. *Abdominales*. Having the ventral behind the pectoral fins.

[1] About 1500 species of fish are now known, and of this number about 200 are found on the coast or in the inland waters of Britain.

Most fish offer us the same external form; sharp at either end, and swelling in the middle; by which they are enabled to traverse the fluid which they inhabit, with greater celerity and ease. That peculiar shape which Nature has granted to most fishes, we endeavour to imitate in such vessels as are designed to sail with the greatest swiftness: however, the progress of a machine moved forward in the water by human contrivance, is nothing to the rapidity of an animal destined by nature to reside there. Any of the large fish overtake a ship in full sail with great ease, play round it without effort, and outstrip it at pleasure. Every part of the body seems exerted in this despatch; the fins, the tail, and the motion of the whole back-bone, assist progression; and it is to that flexibility of body at which art cannot arrive, that fishes owe their great velocity.

The chief instrument in a fish's motion, are the fins, which, in some fish, are much more numerous than in others. A fish completely fitted for sailing, is furnished with not less than two pair; also three single fins, two above and one below. Thus equipped, it migrates with the utmost rapidity, and takes voyages of a thousand leagues in a season. But it does not always happen that such fish as have the greatest number of fins have the swiftest motion; the shark is thought to be one of the swiftest swimmers, yet it wants the ventral or belly fins; the haddock does not move so swift, yet it is completely fitted for motion.

But the fins serve not only to assist the animal in progression, but in rising or sinking, in turning, or even leaping out of the water. To answer these purposes, the pectoral fins serve, like oars, to push the animal forward; they are placed at some little distance behind the opening of the gills; they are generally large and strong, and answer the same purposes to the fish in the water, as wings do to a bird in the air. With the help of these, and by their continued motion, the flying fish is sometimes seen to rise out of the water, and to fly above a hundred yards; till, fatigued with its exertions, it is obliged to sink down again. These also serve to balance the fish's head, when it is too large for the body, and keep it from tumbling down to the bottom, as is seen in large-headed fishes, when the pectoral fins are cut off. Next these are seen the ventral fins, placed towards the lower part of the body, under the belly; these are always seen to lie flat on the water, in whatever situation the fish may be; and they serve rather to raise or depress the fish in its element, than to assist progressive motion. The dorsal fin is situated along the ridge of the back; and serves to keep it in equilibrio, as also to assist its progressive motion. In many fishes this is wanting; but in all flat fishes it is very large, as the pectoral fins are proportionably small. The anal fin occupies that part of the fish which lies between the anus and the tail; and this serves to keep the fish in its upright or vertical situation. Lastly, the tail, which in some fishes is flat, and upright in others, seems the grand instrument of motion; the fins are but all subservient to it, and give direction to its great impetus, by which the fish seems to dart forward with so much velocity. To explain all this by experiment; a carp is taken, and put into a large vessel. The fish, in a state of repose, spreads all its fins, and seems to rest upon its pectoral and ventral fins near the bottom; if the fish folds up (for it has the power of folding) either of its pectoral fins, it inclines to the same side; folding the right pectoral fin, the fish inclines to the right side; folding the left fin, it inclines to that side in turn. When the fish desires to have a retrograde motion, striking with the pectoral fins, in a contrary direction, effectually produces it. If the fish desires to turn, a blow from the tail sends it about; but if the tail strikes both ways, then the motion is progressive. In pursuance of these observations, if the dorsal and ventral fins be cut off, the fish reels to the right and left, and endeavours to supply its loss by keeping the rest of its fins in constant employment. If the right pectoral fin be cut off, the fish leans to that side; if the ventral fin on the same side be cut away, then it loses its equilibrium entirely. When the tail is cut off, the fish loses all motion, and gives itself up to where the water impels it.

From hence it appears, that each of these instruments has a peculiar use assigned it; but, at the same time, that they all conspire to assist each other's motions. Some fish are possessed of all, whose motions are yet not the swiftest; others have but a part, and yet dart in the water with great rapidity. The number, the size, and the situation of the fins, therefore, seem rather calculated to correspond with the animal's figure, than solely to answer the purposes of promoting its speed. Where the head is large and heavy, there the pectoral fins are large, and placed forward, to keep it from oversetting. Where the head is small, or produced out into a long beak, and therefore not too heavy for the tail, the pectoral fins are small, and the ventral fins totally wanting.

As most animals that live upon land are furnished with a covering to keep off the injuries of the weather, so all that live in the water are covered with a slimy glutinous matter, that, like a sheath, defends their bodies from the immediate contact of the surrounding fluid. This substance may be considered as a secretion from the pores of the animal's body:

and serving not only to defend, but to assist the fish's easy progress through the water. Beneath this, in many kinds, is found a strong covering of scales, that, like a coat of mail, defend it still more powerfully; and under that, before we come to the muscular parts of the body, an oily substance, which supplies the requisite warmth and vigour.

The fish thus protected and fitted for motion in its natural element, seems as well furnished with the means of happiness as quadrupeds or birds; but if we come to examine its faculties more nearly, we shall find it very much their inferior. The sense of touching, which beasts and birds have in a small degree, the fish, covered up in its own coat of mail, can have but little acquaintance with.

The sense of smelling, which in beasts is so exquisite, and among birds is not wholly unknown, seems given to fishes in a very moderate proportion.[1] It is true, that all fishes have one or more nostrils; and even those that have not the holes perceptible without, yet have the proper formation of the bones for smelling without. But as air is the only medium we know for the distribution of odours, it cannot be supposed that these animals, residing in water, can be possessed of any power of being affected by them. If they have any perception of smells, it must be in the same manner as we distinguish by our taste; and, it is probable, the olfactory membrane in fish serves them instead of a distinguishing palate; and by this they judge of substances, that, first tincturing the water with their vapours, are thus sent to the nostrils of the fish, and no doubt produce some kind of sensation. This most probably must be the use of that organ in those animals, as otherwise there would be the instruments of a sense provided for them, without any power in them of enjoyment.

As to tasting, they seem to make very little distinction; the palate of most fish is hard and bony, and consequently incapable of the powers of relishing different substances. This sense among quadrupeds, who possess it in some degree, arises from the soft pliancy of the organ, and the delicacy of the skin which covers the instruments of tasting; it may be considered, in them, as a more perfect and delicate kind of feeling: in the bony palate of fish, therefore, all powers of distinguishing are utterly taken away; and we have accordingly often seen these voracious animals swallow the fisherman's plummet instead of the bait.

Hearing in fishes is found still more imperfect, if it be found at all. Certain it is, that anatomists have not been able to discover, except in the whale kind, the smallest traces of an organ, either within or without the head of fishes. It is true, that in the centre of the brain of some fishes are found now and then some little bones, the number and situation of which are entirely accidental. These bones, Mr Klein has supposed to constitute the organ of hearing; but if we consider their entire dissimilitude to the bones that serve for hearing in other animals, we shall be of another opinion. The greatest number of fishes are deprived of these bones entirely: some fish have them in small numbers, and others in abundance; yet neither testify any excellence or defect in hearing. Indeed, of what advantage would this sense be to animals that are incapable of making themselves heard? They have no voice to communicate to each other, and consequently have no need of an organ for hearing. Mr Gouan, who kept some gold fishes in a vase, informs us, that whatever noise he made, he could neither disturb nor terrify them; he halloed as loud as he could, putting a piece of paper between his mouth and the water, to prevent the vibrations from affecting the surface, and the fishes still seemed insensible: but when the paper was removed, and the sound had its full play upon the water, the fishes seemed instantly to feel the change, and shrunk to the bottom. From this we may learn, that fishes are as deaf as they are mute; and that when they seem to hear the call of a whistle or a bell at the edge of a pond, it is rather the vibrations of the sound that affect the water, by which they are excited, than any sounds that they hear.[2]

Seeing seems to be the sense fishes are possessed of in the greatest degree; and yet even this seems obscure, if we compare it to that of other animals. The eye, in almost all fish, is covered with the same transparent skin that covers the rest of the head; and which, probably, serves to defend it in the water, as they are without eyelids. The globe is more depressed anteriorly, and is furnished behind with

[1] There is now no doubt but that fishes possess the sense of smelling. Indeed, it seems to be mostly by their smell that they discover their food.

[2] It was well ascertained by Dr John Hunter that fishes possess the sense of hearing, and that water is an excellent medium for the conveyance of sound. Their organ of hearing is placed on the sides of the skull, or the cavity that contains the brain; but, differing in this respect from that in quadrupeds and birds, it is entirely distinct and detached from the skull. In some fishes, as those of the ray kind, the organ of hearing is wholly surrounded by the parts containing the cavity of the skull; in others, as the salmon and cod, it is in part within the skull. In structure it is by no means so complicated as in the quadrupeds and other animals who live in the air. Some genera, as the rays, have the external orifice very small, and placed on the upper surface of the head; but in others there is no external opening whatever.

a muscle, which serves to lengthen or flatten it, according to the necessities of the animal. The crystalline humour, which in quadrupeds is flat, and of the shape of a button-mould, in fishes is round as a pea; or sometimes oblong, like an egg. From all this it appears that fish are extremely near-sighted; and that even in the water they can see objects at a very small distance. This distance might very easily be ascertained, by comparing the refraction of bodies in the water with that formed by a lens that is spherical. Those unskilled in mathematical calculations, will have a general idea of this, from the glasses used by near-sighted people. Those whose crystalline humour is too convex, or, in other words, too round, are always very near-sighted; and obliged to use concave glasses, to correct the imperfections of nature. The crystalline humour of fish is so round, that it is not in the power of any glasses, much less of water, to correct their vision. This crystalline humour in fishes all must have seen; being that little hard pea-like substance which is found in their eyes after boiling. In the natural state it is transparent, and not much harder than a jelly.

From all this it appears how far fish fall behind terrestrial animals in their sensations, and consequently in their enjoyments.[1] Even their brain, which is by some supposed to be of a size with every animal's understanding, shows that fish are inferior even to birds in this particular. It is divided into three parts, surrounded with a whitish froth, and gives off nerves as well to the sense of sight as of smelling. In some fish it is gray, in others white; in some it is flatted, in others round; but in all extremely small, compared to the bulk of the animal.

Thus Nature seems to have fitted these animals with appetites and powers of an inferior kind; and formed them for a sort of passive existence, in the obscure and heavy element to which they are consigned. To preserve their own existence, and to continue it to their posterity, fill up the whole circle of their pursuits and enjoyments; to these they are impelled rather by necessity than choice, and seem mechanically excited to every fruition. Their senses are incapable of making any distinctions; but they drive forward in pursuit of whatever they can swallow, conquer, or enjoy.

A ceaseless desire of food seems to give the ruling impulse to all their motions. This appetite impels them to encounter every danger; and indeed their rapacity seems insatiable. Even when taken out of the water, and almost expiring, they greedily swallow the very bait by which they were allured to destruction.

The maw is, in general, placed next the mouth, and though possessed of no sensible heat, is, however, endued with a surprising facility of digestion. Its digestive power seems, in some measure, to increase with the quantity of food it is supplied with; a single pike having been known to devour a hundred roaches in three days. Its faculties also are as extraordinary; for it digests not only fish, but much harder substances; prawns, crabs, and lobsters, shells and all. These the cod or the sturgeon will not only devour, but dissolve down, though their shells are so much harder than the sides of the stomach which contains them. This amazing faculty in the cold maw of fishes, has justly excited the curiosity of philosophers; and has effectually overturned the system of those who supposed that the heat of the stomach was alone a sufficient instrument for digestion. The truth seems to be, and some experiments of the skilful Dr Hunter seem to evince, that there is a power of animal assimilation lodged in the

[1] *Comparison by Baron Cuvier between fishes and birds.*—"The aerial being discovers with facility an immense horizon: its subtile ear appreciates every sound, every intonation, which it re-produces with its voice. If its beak is hard, if its body is covered with a kind of down, to preserve it from the intense cold of the high regions which it visits, it finds in its legs all the perfection of the most delicate touch. It enjoys all the sweets of conjugal and paternal love, and it fulfils all its duties with courage. The parents defend each other, and also their offspring,—a most surprising art presides in the construction of their habitations. When the season is come they work together and without remission; while the mother hatches the eggs with an extraordinary patience, the father from an impetuous lover, becomes the most tender husband, and delights with his songs the melancholy of his mate. The bird even in confinement attaches itself to its master; it submits to him, and executes by his order, the most neat and delicate actions; it hunts for him like the dog, and returns at his voice from the greatest height in the air; it imitates even his language, and it is with some degree of difficulty that we are compelled to refuse it a kind of reason.

"The inhabitant of the water does not attach itself. It has no language, no affection; it does not know what it is to be husband and father, or to make an abode for itself. In time of danger it hides itself under the rocks of the ocean, or rushes down into the depths of the sea; its life is monotonous; its voracity leads to its sole employment, and it is only thereby that we are able to direct its motions by certain signs from above. Yet these beings who possess so few enjoyments, have been adorned by nature with all kinds of beauty, variety in their forms, elegance in their proportions, diversity of colour: they have every thing adapted to attract the attention of man, and it seems that it was this attention that nature was desirous to excite. Reflecting the lustre of every metal and precious stone, refracting the colours of the rainbow, in bands, in spots, in undulating, angular, but always regular and symmetrical lines, and always in shades admirably arranged and contrasted; for what purpose have they received these gifts—they who hardly see one another in depths where light can scarcely penetrate, and who, could they gaze on one another, can scarcely be supposed to feel any kind of pleasure by relations thus established?"

stomach of all creatures, which we can neither describe nor define, converting the substances they swallow into a fluid fitted for their own peculiar support. This is done neither by trituration, nor by warmth, nor by motion, nor by a dissolving fluid, nor by their united efforts; but by some principle in the stomach yet unknown, which acts in a different manner from all kinds of artificial maceration. The meat taken into the stomach or maw is often seen, though very near being digested, still to retain its original form, and ready for a total dissolution, while it appears to the eye as yet untouched by the force of the stomach. This animal power is lodged in the maw of fishes, in a greater degree than in any other creatures; their digestive powers are quick, and their appetites are ever craving.

Yet though fish are thus hungry, and for ever prowling, no animals can suffer the want of food for so long a time. The gold and silver fish we keep in vases seem never to want any nourishment at all: whether it be that they feed on the water-insects, too minute for our observation, or that water alone is a sufficient supply, is not evident; but they are often seen for months without apparent sustenance. Even the pike, the most voracious of fishes, will live in a pond where there is none but himself; and what is more extraordinary, will be often found to thrive there.

Still, however, fishes are of all other animals the most voracious and insatiable. Whatever any of them is able to swallow, possessed of life, seems to be considered as the most desirable food. Some that have very small mouths feed upon worms and the spawn of other fish; others, whose mouths are larger, seek larger prey; it matters not of what kind, whether of another or their own. Those with the largest mouths pursue almost every thing that has life; and often meet each other in fierce opposition, when the fish with the largest swallow comes off with the victory and devours its antagonist.

Thus are they irritated by the continual desire of satisfying their hunger; and the life of a fish, from the smallest to the greatest, is but one scene of hostility, violence, and evasion. But the smaller fry stand no chance in the unequal combat; and their usual way of escaping is by swimming into those shallows where the greater are unable, or too heavy to pursue. There they become invaders in turn, and live upon the spawn of larger fish, which they find floating upon the surface of the water; yet there are dangers attending them in every place. Even in the shallows, the mussel, the oyster, and the scallop, lie in ambush at the bottom, with their shells open, and whatever little fish inadvertently approaches into contact, they at once close their shells upon him, and devour the imprisoned prey at their leisure.

Nor is the pursuit of fishes, like that of terrestrial animals, confined to a single region, or to one effort: shoals of one species follow those of another through vast tracks of ocean, from the vicinity of the pole, even down to the equator. Thus the cod, from the banks of Newfoundland, pursues the whiting, which flies before it even to the southern shores of Spain. The cachelot is said, in the same manner, to pursue a shoal of herrings, and to swallow thousands at a gulp.

This may be one cause of the annual migration of fishes from one part of the ocean to the other; but there are other motives which come in aid of this also. Fishes may be induced to change the place of their residence, for one more suited to their constitutions, or more adapted to depositing their spawn. It is remarkable that no fish are fond of very cold waters, and generally frequent those places where it is warmest. Thus, in summer, they are seen in great numbers in the shallows near the shore, where the sun has power to warm the water to the bottom; on the contrary, in winter, they are found towards the bottom in the deep sea; for the cold of the atmosphere is not sufficiently penetrating to reach them at those great depths. Cold produces the same effect upon fresh-water fishes; and when they are often seen dead after severe frosts, it is most probable that they have been killed by the severity of the cold, as well as by their being excluded by the ice from air.

All fish live in the water; yet they all stand in need of air for their support. Those of the whale kind, indeed, breathe air in the same manner as we do, and come to the surface every two or three minutes to take a fresh inspiration; but those which continue entirely under water are yet under a necessity of being supplied with air, or they will expire in a very few minutes. We sometimes see all the fish of a pond killed, when the ice every where covers the surface of the water, and thus keeps off the air from the sub-adjacent fluid. If a hole be made in the ice, the fish will be seen to come all to that part, in order to take the benefit of a fresh supply. Should a carp, in a large vase of water, be placed under an air-pump, and then be deprived of its air, during the operation a number of bubbles will be seen standing on the surface of the fish's body; soon after the animal will appear to breathe swifter, and with greater difficulty; it will then be seen to rise towards the surface, to get more air; the bubbles on its surface begin to disappear; the belly, that was before swollen, will then fall of a sudden; and the animal sinks expiring and convulsed at the bottom.

So very necessary is air to all animals, but particularly to fish, that, as was said, they can live but a few minutes without it; yet nothing is more difficult to be accounted for than the manner in which they obtain this necessary supply. Those who have seen a fish in the water must remember the motion of its lips and its gills, or at least of the bones on each side that cover them. This motion in the animal is, without doubt, analogous to our breathing; but it is not air, but water, that the fish actually sucks in and spouts out through the gills at every motion. The manner of its breathing is thus: the fish first takes in a quantity of water by the mouth, which is driven to the gills; these close and keep the water so swallowed from returning by the mouth; while the bony covering of the gills prevents it from going through them, until the animal has drawn the proper quantity of air from the body of water thus imprisoned: then the bony-covers open, and give it a free passage: by which means also the gills again are opened, and admit a fresh quantity of water. Should the fish be prevented from the free play of its gills, or should the bony-covers be kept from moving, by a string tied round them, the animal would soon fall into convulsions, and die in a few minutes.

But though this be the general method of explaining respiration in fishes, the difficulty remains to know what is done with this air, which the fish in this manner separates from the water. There seems to be no receptacle for containing it; the stomach being the chief cavity within the body, is too much filled with aliment for that purpose. There is indeed a cavity, and that a pretty large one, I mean the air-bladder or swim, which may serve to contain it for vital purposes; but that our philosophers have long destined to a very different use. The use universally assigned to the air-bladder, is the enabling the fish to rise or sink in the water at pleasure, as that is dilated or compressed. The use assigned by the ancients for it was to come in aid of the lungs, and to remain as a kind of store-house of air to supply the animal in its necessities. I own my attachment to this last opinion; but let us exhibit both with their proper share of evidence, and the reader must be left to determine.

The air-bladder is described as a bag filled with air, sometimes composed of one, sometimes of two, and sometimes of three divisions, situated towards the back of the fish, and opening into the maw or gullet. Those who contend that this bag is designed for raising or depressing the fish in the water, build upon the following experiment. A carp being put into the air-pump, and the air exhausted, the bladder is said to expand itself to such a degree, that the fish swells in an extraordinary manner, till the bladder bursts, and then the fish sinks, and ever after continues to crawl at the bottom. On another occasion, the air-bladder was pricked and wounded, which let out its air; upon which the fish sunk to the bottom, and was not seen to rise after. From thence it is inferred, that the use of the air-bladder must be by swelling, at the will of the animal, thus to increase the surface of the fish's body, and thence diminishing its specific gravity, to enable it to rise to the top of the water, and keep there at pleasure. On the contrary, when the fish wants to descend, it is, say they, but to exhaust this bladder of its air; and the fish being thus rendered slimmer and heavier, consequently sinks to the bottom.

Such is the account given of the use of the air-bladder; no part of which seems to me well supported. In the first place, though nothing is more certain than that a carp put into the air-pump will swell, yet so will a mouse or a frog; and these we know to have no air-bladders. A carp will rise to the surface; but so will all fish that want air, whether they have an air-bladder or not. The air-bladder is said to burst in the experiment; but that I deny. The air-bladder is indeed found empty, but it has suffered no laceration, and may be distended by being blown into like any other bladder that is sound. The fish after the experiment, I grant, continues to creep at the bottom; and so will all fish that are sick and wounded, which must be the case with this after such an operation. Thus these facts prove nothing, but that when the fish is killed in an air-pump the air-bladder is found exhausted, and that it will naturally and necessarily be; for the drain of air by which the fish is supplied in the natural way will necessarily oblige it to make use of all its hidden stores; and, as there is a communication between the gullet and the air-bladder, the air which the latter contains will thus be obviously drawn away. But still farther, how comes the air-bladder, according to their hypothesis, to swell under the experiment of the air-pump? What is it that closes the aperture of that organ in such a manner as at last to burst it? or what necessity has the fish for dilating it to that violent degree? At most, it only wants to rise to the surface; and that the fish can easily do without so great a distention of the air-bladder. Indeed it should rather seem that the more the air was wanted without, the less necessity there was for its being uselessly accumulated within; and, to make the modern system consistent, the fish under the air-pump, instead of permitting its bladder to burst, would readily give up its contents; which, upon their supposition, all can do at pleasure.

But the truth is, the fish can neither increase nor diminish the quantity of air in its air-bladder at will, no more than we can that which is contained in our stomachs. The animal has no one muscle, much less a pair of muscles, for contracting or dilating this organ; its aperture is from the gullet; and what air is put into it must remain there till the necessities, and not the will of the animal call it forth as a supply.

But, to put the matter past a doubt, many fish are furnished with an air-bladder, that continually crawl at the bottom; such as the eel and the flounder; and many more are entirely without any bladder, that swim at ease in every depth; such as the anchovy and fresh-water gudgeon.[1] Indeed, the number of fish that want this organ is alone a sufficient proof that it is not so necessary for the purposes of swimming; and as the ventral fins, which in all fish lie flat upon the water, seem fully sufficient to keep them at all depths, I see no great occasion for this internal philosophical apparatus for raising and depressing them. Upon the whole, the air-bladder seems adapted for different purposes than that of keeping the fish at different depths in the water; but whether it be to supply them with air when it is wanted from without, or for what other purpose, I will not take upon me to determine.

Hitherto we have seen fish in every respect inferior to land animals; in the simplicity of their conformation, in their senses, and their enjoyments; but of that humble existence which they have been granted by nature, they have a longer term than any other class of animated nature. "Most of the disorders incident to mankind," says Bacon, "arise from the changes and alterations of the atmosphere; but fishes reside in an element little subject to change; theirs is a uniform existence; their movements are without effort, and their life without labour. Their bones also, which are united by cartilages, admit of indefinite extension; and the different sizes of animals of the same kind, among fishes, is very various. They still keep growing; their bodies, instead of suffering the rigidity of age, which is the cause of natural decay in land animals, still continue increasing with fresh supplies; and as the body grows, the conduits of life furnish their stores in greater abundance. How long a fish, that seems to have scarcely any bounds put to its growth, continues to live, is not ascertained; perhaps the life of a man would not be long enough to measure that of the smallest."

There have been two methods devised for determining the age of fishes which are more ingenious than certain; the one is by the circles of the scales, the other by the transverse section of the back-bone. The first method is this: When a fish's scale is examined through a microscope, it will be found to consist of a number of circles, one circle within another, in some measure resembling those which appear upon the transverse section of a tree, and supposed to offer the same information. For as in trees we can tell their age by the number of their circles, so in fishes we can tell theirs by the number of circles in every scale, reckoning one ring for every year of the animal's existence. By this method, Mr Buffon found a carp, whose scales he examined, to be not less than a hundred years old; a thing almost incredible, had we not several accounts in other authors which tend to confirm the discovery. Gesner brings us an instance of one of the same age; and Albertus of one more than double that period.

The age of the skate and the ray, that want scales, may be known by the other method; which is, by separating the joints of the back-bone, and then minutely observing the number of rings, which the surface where it has joined exhibits. By this the fish's age is said to be known; and perhaps with as much certainty as in the former instance.

But how unsatisfactory soever these marks may be, we have no reason to doubt the great age of some fishes. Those that have ponds, often know the oldest by their superior size. But the longevity of these animals is nothing when compared to their fecundity. All sorts, a few of the larger ones excepted, multiply their kind, some by hundreds, and some by millions. There are some that bring forth their young alive, and some that only produce eggs: the former are rather the least fruitful; yet even these are seen to produce in great abundance. The viviparous blenny, for instance, brings forth two or three hundred at a time, all alive, and playing round the parent together. Those who exclude their progeny in a more imperfect state, and produce eggs, which they are obliged to leave to chance, either on the bottom, at the edge of the water, or floating on the surface where it is deeper, are all much more prolific; and seem to proportion their stock to the danger there is of its consumption. Of these eggs thus deposited, scarcely one in a hundred brings forth an animal; they are devoured by all the lesser fry that frequent the shores; by aquatic birds near the margin; and by the larger fish in deep water. Still, however, there are enough for supplying the deep with inhabitants; and, notwithstanding their own rapacity, and that of the fowls of various tribes, the numbers that escape are sufficient to relieve the wants of a very considerable

[1] Redi.

part of mankind. Indeed, when we consider the numbers that a single fish is capable of producing, the amount will seem astonishing. If, for instance, we should be told of a being so very prolific, that in a single season it could bring forth as many of its kind as there are inhabitants in England, it would strike us with surprise; yet a single cod produces full that number. The cod spawns in one season, as Lewenhoeck assures us, above nine millions of eggs or peas, contained in one single roe. The flounder is commonly known to produce above one million; and the mackarel above five hundred thousand. Such an amazing increase, if permitted to come to maturity, would overstock nature, and even the ocean itself would not be able to contain, much less to provide for, the half of its inhabitants. But two wise purposes are answered by this amazing increase; it preserves the species in the midst of numberless enemies, and serves to furnish the rest with a sustenance adapted to their nature.

Fishes seem, all except the whale kind, entirely divested of those parental solicitudes which so strongly mark the manners of the more perfect terrestrial animals. How far they copulate remains as yet a doubt; for though they seem to join, yet the male is not furnished with any external instrument of generation. It is said, by some, that his only end in that action is to emit his impregnated milt upon the eggs that at that time fall from the female. He is said to be seen pursuing them as they float down the stream, and carefully impregnating them one after another. On some occasions also the females dig holes in the bottom of rivers and ponds, and there deposit their spawn, which is impregnated by the male in the same manner. All this, however, is very doubtful; what we know with certainty of the matter, and that not discovered till very lately, is, that the male has two organs of generation, that open into the bladder of urine, and that these organs do not open into the rectum as in birds, but have a particular aperture of their own.[1] These organs of generation in the male are empty at some seasons of the year; but before the time of spawning they are turgid with what is called the milt, and emit the fluid proper for impregnation.

Fish have different seasons for depositing their spawn: some, that live in the depths of the ocean, are said to choose the winter months: but, in general, those with which we are acquainted, choose the hottest months in summer, and prefer such water as is somewhat tepified by the beams of the sun. They then leave the deepest parts of the ocean, which are the coldest, and shoal round the coasts, or swim up the fresh-water rivers, which are warm as they are comparatively shallow. When they have deposited their burdens they then return to their old stations, and leave their nascent progeny to shift for themselves.

The spawn continues in its egg-state in some fish longer than in others, and this in proportion to the animal's size. In the salmon, for instance, the young animal continues in the egg from the beginning of December till the beginning of April; the carp continues in the egg not above three weeks; the little gold fish from China is produced still quicker. These all, when excluded, at first escape by their minuteness and agility. They rise, sink, and turn, much readier than grown fish; and they can escape into very shallow waters when pursued. But, with all their advantages, scarcely one in a thousand survives the numerous perils of its youth. The very male and female that have given them birth are equally dangerous and formidable with the rest, forgetting all relation at their departure.

Such is the general picture of these heedless and hungry creatures; but there are some in this class, living in the waters, that are possessed of finer organs and higher sensations; that have all the tenderness of birds or quadrupeds for their young, that nurse them with constant care, and protect them from every injury. Of this class are the *cetaceous* tribe, or the fishes of the whale kind. There are others, though not capable of nursing their young, yet that bring them alive into the world, and defend them with courage and activity. These are the *cartilaginous* kinds, or those who have gristles instead of bones. But the fierce unmindful tribe we have been describing, that leave their spawn without any protection, are called the *spinous*, or bony kinds, from their bones resembling the sharpness of thorns.

Thus there are three grand divisions in the fish kind; the *cetaceous*, the *cartilaginous*, and the *spinous*: all differing from each other in their conformation, their appetites, in their bringing forth, and in the education of their young. These three great distinctions are not the capricious differences formed by a maker of systems, but are strongly and firmly marked in Nature. These are the distinctions of Aristotle; and they have been adopted by mankind ever since his time. It will be necessary, therefore, to give the history of each of these in particular; and then to arrange, under each head, those fishes whose history is the most remarkable; or, more properly speaking, those of which we have any history. For we shall find, when we come to any of the species in particular, how little

[1] Vide Gaman de Generatione Piscium.

can be said of their habits, their stations, or method of propagation.

Much, indeed, can be said of them if considered relatively to man ; and large books have been written of the manner of taking fish, or of dressing them. Apicius is noted for first having taught mankind to suffocate fish in Carthaginian pickle ; and Quin, for giving a sauce to the Johndory : Mrs Glasse is famous for her eel-pie, and Mr Tull for his invention of spaying carp, to give it a finer flavour. In this manner our cooks handle the subject. On the other hand, our physicians assure us that the flesh of fishes yields little nourishment, and soon corrupts ; that it abounds in a gross sort of oil and water, and hath but a few volatile particles, which render it less fit to be converted into the substance of our bodies. They are cold and moist, and must needs, say they, produce juices of the same kind, and consequently are improper to strengthen the body. In this diversity of opinion, it is the wisest way to eat our fish in the ordinary manner, and pay no great attention to cooks or doctors.

I cannot conclude this chapter without putting a question to the learned, which I confess I am not able to resolve. How comes it that fish, which are bred in a salt element, have yet no salt to the taste, or that is capable of being extracted from them.[1]

CHAP. II.

OF CETACEOUS FISHES IN GENERAL.

As on land there are some orders of animals that seem formed to command the rest, with greater powers and more various instincts, so in the ocean there are fishes which seem formed upon a nobler plan than others, and that, to their fishy form, join the appetites and the conformation of quadrupeds. These are all of the *cetaceous* kind ; and so much raised above their fellows of the deep, in their appetites and instincts, that almost all our modern naturalists have fairly excluded them from the finny tribes, and will have them called, not fishes, but *great beasts of the ocean.* With them it would be as improper to say men go to Greenland fishing for whale, as it would be to say that a sportsman goes to Blackwall a fowling for mackarel.

Yet, notwithstanding philosophers, mankind will always have their own way of talking ; and, for my own part, I think them here in the right. A different formation of the lungs, stomach, and intestines ; a different manner of breathing or propagating ; are not sufficient to counterbalance the great obvious analogy which these animals bear to the whole finny tribe. They are shaped as other fishes ; they swim with fins ; they are entirely naked, without hair ; they live in the water, though they come up to breathe ; they are only seen in the depths of the ocean, and never come upon shore but when forced thither. These, sure, are sufficient to plead in favour of the general denomination, and acquit mankind of error in ranking them with their lower companions of the deep.

But still they are many degrees raised above other fishes in their nature, as they are in general in their size. This tribe is composed of the Whale and its varieties, of the Cachalot, the Dolphin, the Grampus, and the Porpoise. All these resemble quadrupeds in their internal structure, and in some of their appetites and affections. Like quadrupeds, they have lungs, a midriff, a stomach, intestines, liver, spleen, bladder, and parts of generation ; their heart also resembles that of quadrupeds, with its partitions closed up as in them, and driving red and warm blood in circulation through the body. In short, every internal part bears a most striking similitude ; and to keep these parts warm, the whole kind are also covered, between the skin and the muscles, with a thick coat of fat or blubber, which, like the bacon fat of a hog, keeps out the cold, renders their muscles glib and pliant, and probably makes them lighter in swimming.

As these animals breathe the air, it is obvious that they cannot bear to be any long time under water. They are constrained, therefore, every two or three minutes, to come up to the surface to take breath, as well as to spout out through their nostril (for they have but one) that water which they sucked in while gaping for their prey. This conduit by which they breathe, and also throw out the water, is placed in the head, a little before the brain. Though externally the hole is but single, it is internally divided by a bony partition, which is closed by a sphincter muscle on the inside, that, like the mouth of a purse, shuts it up at the pleasure of the animal.

[1] Though fishes live in a salt element they do not subsist on it. All the water they take into their mouths is again discharged through the gills, after retaining the air contained in it for the purposes of life. The medium of water answers the precise purpose to fishes, that the medium of air does to man and other land animals. In inspiration, the element is received into the lungs or gills, and in expiration is returned deprived of its purer parts, which are retained for the purpose of animal economy. And whatever salt may be taken into the stomachs of fishes with their food, is decomposed and separated into its component parts of acid and soda. The sailor that feeds for twelve months together on salted meats, has not his own flesh made salt; but a decomposition taking place during the process of digestion, he becomes corrupted and scorbutic by the excess of soda and magnesia.

There is also another muscle or valve, which prevents the water from going down the gullet. When therefore, the animal takes in a certain quantity of water, which is necessary to be discharged and separated from its food, it shuts the mouth, closes the valve of the stomach, opens the sphincter that kept the nostril closed, and then breathing strongly from the lungs, pushes the water out by effort, as we see it rise by the pressure of air in a fire-engine.

The senses of these animals seem also superior to those of other fishes. The eyes of other fishes, we have observed, are covered only with transparent skin that covers the rest of the head; but in all the cetaceous kinds, it is covered by eye-lids, as in man. This, no doubt, keeps that organ in a more perfect state, by giving it intervals of relaxation, in which all vision is suspended. The other fishes, that are for ever staring, must see, if for no other reason, more feebly, as their organs of sight are always exerted.

As for hearing, these also are furnished with the internal instruments of the ear, although the external orifice no where appears. It is most probable that this orifice may open by some canal, resembling the Eustachian tube, into the mouth; but this has not as yet been discovered.

Yet Nature sure has not thus formed a complete apparatus for hearing, and denied the animal the use of it when formed. It is most likely that all animals of the cetaceous kind can hear, as they certainly utter sounds, and bellow to each other. This vocal power would be as needless to animals naturally deaf, as glasses to a man that was blind.

But it is in the circumstances in which they continue their kind, that these animals show an eminent superiority. Other fish deposit their spawn, and leave the success to accident; these never produce above one young, or two at the most; and this the female suckles entirely in the manner of quadrupeds, her breasts being placed, as in the human kind, above the navel. We have read many fabulous accounts of the nursing of the demigods of antiquity, of their feeding on the marrow of lions, and their being suckled by wolves: one might imagine a still more heroic system of nutrition, if we supposed that the young hero was suckled and grew strong upon the breast-milk of a she-whale!

The whale or the grampus are terrible at any time; but are fierce and desperate in the defence of their young. In Waller's beautiful poem of the Summer Islands, we have a story, founded upon fact, which shows the maternal tenderness of these animals for their offspring. A whale and her cub had got in an arm of the sea, where, by the desertion of the tide, they were inclosed on every side. The people from shore soon saw their situation, and drove down upon them in boats, with such weapons as the urgent occasion offered. The two animals were soon wounded in several places, and the whole sea round was tinctured with their blood. The whales made several attempts to escape; and at last the old one, by its superior strength, forced over the shallow into the depths of the ocean. But though in safety herself, she could not bear the danger that awaited her young one; she therefore rushed in once more where the smaller animal was imprisoned, and resolved, when she could not protect, at least to share its danger.—The story ends with poetical justice; for the tide coming in, brought off both in safety from their enemies, though not without sustaining an infinite number of wounds on every part.

As to the rest, the distinctive marks of this tribe are, that the number of their fins never exceed three; namely, two pectoral fins, and one back fin; but in some sorts the last is wanting. These fins differ very much from those of other fishes, which are formed of straight spines: the fins of the cetaceous tribe are made up of bones and muscles; and the skeleton of one of their fins very much resembles the skeleton of a man's hand. Their tails also are different from those of all other fish: they are placed so as to lie flat on the surface of the water; while the other kinds have them, as we every day see, upright or edgeways. This flat position of the tail in cetaceous animals, enables them to force themselves suddenly to the surface of the water to breathe, which they are continually constrained to do.

Of these enormous animals some are without teeth, and properly called whales: others have the teeth only in the lower jaw, and are called, by the French, cachalots: the narwhal has teeth only in the upper jaw: the dolphin's teeth as well as those of the porpoise and grampus, are both above and below. These are the marks that serve to distinguish the kinds of this enormous tribe from each other; and these shall serve to guide us in giving their history.

CHAP. III.

OF THE WHALE PROPERLY SO CALLED, AND ITS VARIETIES.

If we compare land animals, in respect to magnitude, with those of the deep, they will appear contemptible in the competition. It is probable, indeed, that quadrupeds once existed much larger than we find them at pre-

sent. From the skeletons of some that have been dug up at different times, it is evident that there must have been terrestrial animals twice as large as the elephant; but creatures of such an immense bulk required a proportionable extent of ground for subsistence, and, by being rivals with men for large territory, they must have been destroyed in the contest.

But it is not only upon land that man has exerted his power of destroying the larger tribes of animated nature, he has extended his efforts even into the midst of the ocean, and has cut off numbers of those enormous animals, that had perhaps existed for ages. We now no longer hear of whales two hundred, and two hundred and fifty feet long, which we are certain were often seen about two centuries ago. They have all been destroyed by the skill of mankind, and the species is now dwindled into a race of diminutive animals, from thirty to about eighty feet long.

The northern seas were once the region to which the greatest of these animals resorted; but so great has been the slaughter of whales for more than two ages, that they begin to grow thinner every day; and those that are now found there, seem, from their size, not to come to their full dimensions. The greatest whales resort to places where they have the least disturbance; to those seas that are on the opposite side of the globe, near the south pole. In that part of the world there are still to be seen whales that are above a hundred and sixty feet long; and perhaps even longer might be found in those latitudes near the south pole, to which we have not as yet ventured.

Taking the whale, however, at the ordinary size of eighty feet long and twenty feet high, what an enormous animated mass must it appear to the spectator! With what amazement must it strike him, to behold so great a creature gamboling in the deep, with the ease and agility of the smallest animal, and making its way with incredible swiftness! This is a sight which is very common to those who frequent the northern or southern ocean. Yet though this be wonderful, perhaps still greater wonders are concealed in the deep, which we have not had opportunities of exploring. These large animals are obliged to show themselves in order to take breath; but who knows the size of those that are fitted to remain for ever under water, and that have been increasing in magnitude for centuries! To believe all that has been said of the Sea-Serpent, or the Kraken, would be credulity; to reject the possibility of their existence, would be presumption.

The Whale is the largest animal of which we have any certain information; and the various purposes to which, when taken, its different parts are converted, have brought us tolerably acquainted with its history. Of the whale, properly so called, there are no less than seven different kinds; all distinguished from each other by their external figure, or internal conformation. The Great Greenland Whale, without a back-fin, and black on the back; the Iceland Whale, without a back-fin, and whitish on the back; the New-England Whale, with a hump on the back; the Whale with six humps on the back; the Fin-fish, with a fin on the back near the tail; the Pike-headed Whale, and the Round-lipped Whale. All these differ from each other in figure, as their names obviously imply. They differ also somewhat in their manner of living; the fin-fish having a larger swallow than the rest, being more active, slender, and fierce, and living chiefly upon herrings. However, there are none of them very voracious; and, if compared to the cachalot, that enormous tyrant of the deep, they appear harmless and gentle. The history of the rest, therefore, may be comprised under that of the Great Common Greenland Whale, with which we are best acquainted.

The Great Greenland Whale (see Plate XIV. fig. 23.) is the fish, for taking which there are such preparations made in different parts of Europe. It is a large heavy animal, and the head alone makes a third of its bulk. It is usually found from sixty to seventy feet long. The fins on each side are from five to eight feet, composed of bones and muscles, and sufficiently strong to give the great mass of body which they move, speed and activity. The tail, which lies flat on the water, is about twenty-four feet broad; and, when the fish lies on one side, its blows are tremendous. The skin is smooth and black, and, in some places, marbled with white and yellow; which, running over the surface, has a very beautiful effect. This marbling is particularly observable in the fins and the tail. In the figures which are thus drawn by nature, fancy often forms the pictures of trees, landscapes, and houses. In the tail of one that was thus marbled, Ray tells us, that the number 122 was figured very evenly and exact, as if done with a pencil.

The whale makes use only of the tail to advance itself forward in the water. This serves as a great oar to push its mass along; and it is surprising to see with what force and celerity its enormous bulk cuts through the ocean. The fins are only made use of for turning in the water, and giving a direction to the velocity impressed by the tail. The female also makes use of them when pursued, to bear off her young, clapping them on her back, and supporting them by the fins on each side from falling.

The outward or scarf skin of the whale is no

thicker than parchment; but this removed, the real skin appears, of about an inch thick, and covering the fat or blubber that lies beneath; this is from eight to twelve inches in thickness; and is, when the fish is in health, of a beautiful yellow. The muscles lie beneath; and these, like the flesh of quadrupeds, are very red and tough.

The cleft of the mouth is above twenty feet long, which is near one-third of the animal's whole length; and the upper jaw is furnished with barbs, that lie like the pipes of an organ, the greatest in the middle, and the smallest to the sides. These compose the whalebone; the longest spars of which are found to be not less than eighteen feet; the shortest, being of no value, are thrown away. The tongue is almost immovably fixed to the lower jaw, seeming one great lump of fat; and, in fact, it fills several hogsheads with blubber. The eyes are not larger than those of an ox; and when the crystalline humour is dried, it does not appear larger than a pea. They are placed towards the back of the head, being the most convenient situation for enabling them to see both before and behind; as also to see over them, where their food is principally found. They are guarded by eye-lids and eye-lashes, as in quadrupeds; and they seem to be very sharp-sighted.

Nor is their sense of hearing in less perfection; for they are warned at great distances, of any danger preparing against them. It would seem as if nature had designedly given them these advantages, as they multiply little, in order to continue their kind. It is true, indeed, that the external organ of hearing is not perceptible, for this might only embarrass them in their natural element: but as soon as the thin scarf-skin above mentioned is removed, a black spot is discovered behind the eye, and under that is the auditory canal, that leads to a regular apparatus for hearing. In short, the animal hears the smallest sounds at very great distances, and at all times, except when it is spouting water; which is the time that the fishers approach to strike it.

These spout holes or nostrils, in all the cetaceous tribe, have been already described: in this whale there are two, one on each side the head before the eyes, and crooked, somewhat like the holes on the belly of a violin. From these holes this animal blows the water very fiercely, and with such a noise, that it roars like a hollow wind, and may be heard at three miles distance. When wounded, it then blows more fiercely than ever, so that it sounds like the roaring of the sea in a great storm.

We have already observed, that the substance called whale-bone, is taken from the upper jaw of the animal, and is very different from the real bones of the whale. The real bones are hard, like those of great land animals, are very porous, and filled with marrow. Two great strong bones sustain the upper lip, lying against each other in the shape of a half-moon: some of these are twenty-feet long; they are seen in several gardens set up against each other, and are usually mistaken for the ribs of this animal.

Such is the general conformation and figure of this great inhabitant of the deep, the precise anatomy of which has not been yet ascertained. In those places where they are caught in greatest abundance, the sailors are not very curious as to the structure of the viscera; and few anatomists care to undertake a task where the operator, instead of separating with a lancet, must cut his way with an axe. It is as yet doubted, therefore, whether the whale, that in most points internally resembles a quadruped, may not have one great bowel fitted entirely for the reception of air, to supply it, when constrained to keep longer than usual at the bottom. The sailors universally affirm that it has; and philosophers have nothing but the analogy of its parts to oppose to their general assertions.

As these animals resemble quadrupeds in conformation, so they bear a strong resemblance in some of their appetites and manners. The female joins with the male, as is asserted, *more humano*, and once in two years feels the accesses of desire.

Their fidelity to each other exceeds whatever we are told of even the constancy of birds. Some fishers, as Anderson informs us, having struck one of two whales, a male and a female, that were in company together, the wounded fish made a long and terrible resistance: it struck down a boat with three men in it, with a single blow of the tail, by which all went to the bottom. The other still attended its companion, and lent it every assistance; till, at last, the fish that was struck sunk under the number of its wounds; while its faithful associate, disdaining to survive the loss, with great bellowing stretched itself upon the dead fish, and shared its fate.

The whale goes with young nine or ten months, and is then fatter then usual, particularly when near the time of bringing forth. It is said that the embryo, when first perceptible, is about seventeen inches long, and white; but the cub, when excluded, is black, and about ten feet long. She generally produces one young one, and never above two. When she suckles her young, she throws herself on one side on the surface of the sea, and the young one attaches itself to the teat. The breasts are two, generally hid within the belly; but she can produce them at pleasure, so as to stand forward a foot and a half, or two

feet; and the teats are like those of a cow. In some, the breasts are white; in others speckled; in all, filled with a large quantity of milk, resembling that of land animals.

Nothing can exceed the tenderness of the female for her offspring; she carries it with her wherever she goes, and, when hardest pursued, keeps it supported between her fins. Even when wounded, she still clasps her young one; and when she plunges to avoid danger, takes it to the bottom; but rises sooner than usual, to give it breath again.

The young ones continue at the breast for a year; during which time they are called by the sailors, *short-heads*. They are then extremely fat, and yield above fifty barrels of blubber. The mother, at the same time, is equally lean and emaciated. At the age of two years they are called *stunts*, as they do not thrive much immediately after quitting the breast; they then scarcely yield above twenty, or twenty-four, barrels of blubber: from that forward, they are called *skull-fish*, and their age is wholly unknown.

Every species of whale propagates only with those of its own kind, and does not at all mingle with the rest; however they are generally seen in shoals, of different kinds together, and make their migrations in large companies, from one ocean to another. They are a gregarious animal, which implies their want of mutual defence against the invasions of smaller, but more powerful, fishes. It seems astonishing, therefore, how a shoal of these enormous animals find subsistence together, when it would seem that the supplying even one with food would require greater plenty than the ocean could furnish. To increase our wonder, we not only see them herding together, but usually find them fatter than any other animals of whatsoever element. We likewise know that they cannot swallow large fishes, as their throat is so narrow, that an animal larger than a herring could not enter. How then do they subsist and grow so fat?—A small insect, which is seen floating in those seas, and which Linnæus terms the Medusa, is sufficient for this supply. These insects are black, and of the size of a small bean, and are sometimes seen floating in clusters on the surface of the water. They are of a round form, like snails in a box, but they have wings, which are so tender, that it is scarcely possible to touch them without breaking. These serve rather for swimming than flying; and the little animal is called by the Icelanders, the Walfishoas, which signifies the whale's provender. They have the taste of raw mussels, and have the smell of burnt sugar. These are the food of the whale, which it is seen to draw up in great numbers with its huge jaws, and to bruise between its barbs, which are always found with several of these sticking among them.

This is the simple food of the great Greenland whale; it pursues no other animal, leads an inoffensive life in its element, and is harmless in proportion to its strength to do mischief.[1] There seems too an analogy between

[1] "Among the cetaceous tribes," says the Edinburgh Cabinet Library, vol. I. on the Polar Regions, "the chief place is due to the whale, of all animals 'mightiest that swim the ocean stream.' Enormous as his bulk is, rumour and the love of the marvellous have represented it as being at one time much greater, and the existing race as only the degenerate remnant of mightier ancestors. Mr Scoresby, however, by collecting various good authorities, has proved that sixty feet was always nearly the utmost length of the *mysticetus*, or great Greenland whale. Of three hundred and twenty-two individuals, in the capture of which that gentleman was concerned, none occurred of a length exceeding fifty-eight feet; and he gives no credence to any rumour of a specimen which exceeded seventy feet. Even sixty feet implies a weight of seventy tons, being nearly that of three hundred fat oxen. Of this vast mass, the oil of a rich whale composes about thirty tons, and when, as was the case some years ago, that article brought £55 or £60 per ton, we may form some idea of the great value of the capture; the bones of the head, fins, and tail, weigh eight or ten; the carcass, thirty or thirty-two tons. The oleaginous substance, or blubber, the most valuable part of the animal, forms a complete wrapper round the whole body, of the thickness of from eight to twenty inches. The head is disproportionally large, forming about a third of the entire bulk. The basis consists of the crown-bone, from each side of which descend those immense jaw-bones which are sometimes presented to our wondering eyes, and which the whalers place on deck as trophies of their success, and in order that the fine oil contained in them may ooze from their lower extremities. These jaw-bones are from sixteen to twenty feet in length, and extend along the mouth in a curved line, till they meet and form a species of crescent. The lips, nearly twenty feet long, display, when open, a cavity capable of receiving a ship's jolly-boat with her crew. The whale has no external ear; but when the skin is removed, a small aperture is discerned for the admission of sound. This sense accordingly is very imperfect; yet the animal, by a quick perception of all movements made on the water, discovers danger at a great distance. The eyes are proportionally small, though the sense of seeing is acute; more so, however, through clear water than through an aerial medium. But the most unique feature in the structure of this animal consists in the *spiracles* or blow-holes placed nearly on the crown of the head. These have been compared to natural *jets d'eau* throwing up water to the height of forty or fifty feet; but the more careful scrutiny of Mr Scoresby ascertained that they emit only a moist vapour, and are neither more nor less than huge nostrils. When, however, this vehement breathing or blowing is performed under the surface, a considerable quantity of water is thrown up into the air. The sound thus occasioned is the only thing like a voice emitted by the animal, and, in the case of a violent respiration, it resembles the discharge of a cannon.

"The tail is the most active limb of this mighty animal, and the chief instrument of his motion. It does not rise vertically like that of most fishes, being flat and horizontal, only four or five feet long, but more than twenty feet broad. It consists of two beds of muscles connected with an extensive layer surrounding the body, and enclosed by a thin covering of

its manners and those of the elephant. They are both the strongest and the largest animals in their respective elements; neither offer injury, but are terrible when provoked to resentment. The fin-fish indeed, in some measure, differs from the great whale in this particular, as it subsists chiefly upon herrings, great shoals of which it is often seen driving before

blubber. Its power is tremendous. A single stroke throws a large boat with all its crew into the air. Sometimes the whale places himself in a perpendicular position with the head downwards, and, rearing his tail on high, beats the water with awful violence. On these occasions the sea foams, and vapours darken the air, the lashing is heard several miles off, like the roar of a distant tempest. Sometimes he makes an immense spring, and rears his whole body above the waves, to the admiration of the experienced whaler, but to the terror of those who see for the first time this astonishing spectacle. Other motions, equally expressive of his boundless strength, attract the attention of the navigator at the distance of miles."

There are various kinds of whales. That already described is the mysticetus, or the right whale, as he is called by British sailors, on account of his superior quantity of blubber having pointed him out as the most proper subject for the fishery. The *razor back* (*Balæna physalis*) is larger, more formidable, but has much less oil, and is never attacked, unless by mistake. The *cachalot* or spermaceti whales, which chiefly abound in the Southern Polar ocean, are gregarious; that is to say, they usually appear in large herds. Their oil is small in quantity, but is much esteemed. The *narwal* is seldom above sixteen feet in length, and has a tusk projecting above its upper jaw, from which the sailors call him the sea unicorn.

When we consider the enormous bulk of the most of cetaceous animals, we shall be surprised at the rapidity of motion which is a general character of the tribe. It has been computed that some of them are capable of rushing through thirty-three feet in a second of time, and that, supposing them to proceed with an uniform and uninterrupted motion, twenty-three days would be sufficient for enabling them to circumnavigate the globe. Though the mouth of the whale is so large, that, in some individuals, several men have been able to stand upright in the inside of it, the throat is in general so very narrow as to admit of only a small object passing. Some kinds are furnished with teeth; but the balænæ, instead of those organs, have a curious apparatus, from which the well-known substance called *whalebone* is derived. According to the description given by Baron Cuvier, "the maxillary (cheek) bones in this tribe, form on their inferior surface two inclined planes, which give to the palate the appearance of the roof of a house reversed, and their two surfaces are concave. To these are attached a series of laminæ (thin plates) parallel to each other, and having a transverse direction with regard to the axis of the body. Several hundred laminæ may be counted on each side, and in the Greenland whale they often exceed ten feet in length. The laminæ present on their internal sides layers of horny fibres, growing from the horny plates, but less fine, and which form a fringe or loose border hanging down upon and investing the whole bulk of the tongue. The use of this apparatus seems to be to retain, as with a net, those small animals which the whales seize and swallow for food.

Against these mighty animals man wages a war so exterminating as to have driven them from their ancient haunts to seek for safety in the more inaccessible parts of the ocean; hither, however, they are followed and killed, in order to obtain the immense quantity of oil which they yield, and of which we are now to speak. Fat, or oil, which is lighter than water, is abundantly supplied to fishes, in order to counteract their

tendency to sink in this fluid. The solid parts of their bodies, as indeed of all other animals, being heavier than water, it is evident, that, unless provided with a sufficient supply of some substance lighter than water, it would have required a constant effort, on their parts, to keep themselves at any given level. Now, the quantity of fat with which fishes are in general furnished, being very nearly in the same proportion to the solid parts as to bring their body, collectively taken, to about the same specific gravity as that of the water which they inhabit, supersedes in them the necessity of making any efforts except for the purpose of changing their position. We all know of how oleaginous a nature is the flesh of many fishes commonly brought to table, as the salmon and the eel; and in the internal parts of fishes in general the quantity of fat is still more remarkable. The gall of fishes is little else than a kind of oil, and it is well known what large quantities of this may be got from the livers of the cod, ling, and others in every-day use.

Now, it is for the same purpose of diminishing their specific gravity that the cetaceous tribes are furnished, like fishes, with a prodigious quantity of fat; for it must be remembered that they require not merely to be kept at any given level below the water, but to be raised again to the surface, as often as they have dived below it. This is the main use of the enormous quantity of oil which is found in these animals, situated for the most part in what is called the blubber immediately under the skin—as the substance called lard is under that of the hog—and constituting the train-oil of commerce. But besides this mass of subcutaneous fat many cetaceous animals, as the bottle-nosed or spermaceti whale (*Physeter macrocephalus*), have a second collection of a similar substance, except that it is of a purer quality and firmer consistence, in a large reservoir at the top of the head, near the part where the pulmonary spiracles open. This is the substance known in the shops by the name of spermaceti; and as the oil of the blubber serves to render the body collectively lighter than the water which these animals inhabit, so the spermaceti serves to render the top of the head the most buoyant part of the body, so that it is kept above the surface without any exertion. The quantity of train-oil procured from the great northern whale amounts frequently to one-twelfth of the weight of its enormous carcase; the tongue alone, which is said to be "about the size of a great feather-bed," often yielding five or six barrels; and when we are informed that the cavity in the skull of the bottle-nosed whale, appropriated to the reception of the spermaceti, is often sixteen or eighteen feet long, and of a proportionate breadth, we may form some idea of the quantity of this substance which it contains. Such, then, is the source of the oil for which men endure such privations, and brave such dangers, and have done so from very ancient times; for the whale-fishery is of long standing. Although the Norwegians probably captured the whale before any other European nation engaged in so perilous an undertaking, the Biscayans were the first to prosecute it as a regular commercial pursuit. They carried it on with great vigour and success in the twelfth, thirteenth, and fourteenth centuries. In 1261, we find from the work of Noel, "Sur l'Antiquité de la Peche de la Baleine," that a tithe was laid upon the tongues of whales imported into Bayonne, they being then a highly esteemed species of food. In 1338, Edward III. relinquished to Peter de Puyanne a duty of £6 sterling each

it. Yet even the swallow of this fish is not very large, if compared to the cachalot tribe; and its ravages are but sports in comparison. The stomach and intestines of all these animals, when opened, seldom have any thing in them, except a soft unctuous substance of a brownish colour; and their excrements are of a shining red.

As the whale is an inoffensive animal, it is not to be wondered that it has many enemies willing to take advantage of its disposition, and inaptitude for combat. There is a small animal, of the shell-fish kind, called the *Whale-louse*, that sticks to its body, as we see shells sticking to the foul bottom of a ship. This insinuates itself chiefly under the fins; and whatever efforts the great animal makes, it still keeps its hold, and lives upon the fat, which it is provided with instruments to arrive at.

The sword-fish, however, is the whale's most terrible enemy. "At the sight of this little animal," says Anderson, "the whale seems agitated in an extraordinary manner; leaping from the water as if with affright: wherever it appears, the whale perceives it at a distance, and flies from it in the opposite direction. I have been myself," continues he, "a spectator of their terrible encounter. The whale has no instrument of defence except the tail; with that it endeavours to strike the enemy; and a single blow taking place, would effectually destroy its adversary: but the sword-fish is as active as the other is strong, and easily avoids the stroke; then bounding into the air, it falls upon its great subjacent enemy, and endeavours not to pierce with its pointed beak, but to cut it with its toothed edges. The sea all about is seen dyed with blood, proceeding from the wounds of the whale; while the enormous animal vainly endeavours to reach its invader, and strikes with its tail against the surface of the water, making a report at each blow louder than the noise of a cannon.

There is still another and more powerful enemy, called by the fishermen of New-England, *the Killer*. This is itself a cetaceous animal, armed with strong and powerful teeth. A number of these are said to surround the whale, in the same manner as dogs get round a bull. Some attack it with their teeth behind; others attempt it before, until at last the great animal is torn down, and its tongue is said to be the only part they devour when they have made it their prey. They are said to be of such great strength, that one of them alone was known to stop a dead whale that several boats were towing along, and drag it from among them to the bottom.

But of all the enemies of these enormous fishes, man is the greatest: he alone destroys more in a year than the rest in an age, and actually has thinned their numbers in that part of the world where they are chiefly sought. The great resort of these animals was found to be on the inhospitable shores of Spitzbergen; where the distance of the voyage, the coldness of the climate, the terrors of the icy sea, and, still more, their own formidable bulk, might have been expected to protect them from human injury. But all these were but slight barriers against man's arts, his courage, and his necessities. The European ships, soon after the improvement of navigation, found the way into those seas; and as early as the beginning of the fourteenth century, the Biscayneers were in possession of a very considerable trade to the coast of Greenland. The Dutch and the English followed them thither, and soon took that branch of commerce out of their hands. The English commenced the business about the beginning of the seventeenth century; and the town of Hull had the honour of first attempting that profitable branch of trade. But, at present, it seems upon the decline, as the quantity of fish is so greatly reduced, by the constant capture for such a vast length of time. It is now said that the fishers, from a defect of whales, apply themselves to the seal-fishery; yet, as these animals are ex-

whale, laid on those brought into the port of Biarritz, to indemnify him for the extraordinary expenses he had incurred in fitting out a fleet for the service of his majesty. The Biscayans, however, soon gave up the whale-fishing, from the want of fish, which ceased to come southward, no longer leaving the icy seas. The voyages of the Dutch and English to the Northern ocean, in order to discover a passage through it to India, though they failed in their primary object, laid open the remote haunts of the whale. The Muscovy company now obtained a royal charter, prohibiting all vessels but theirs from fishing in the seas round Spitzbergen, under pretence that it was discovered by Sir Hugh Willoughby. The fact, however, was, that Barentz discovered it in 1596; and the company, after several severe and bloody encounters, soon found themselves beaten from the ground by the Dutch, who being left quietly and undisturbed to prosecute the fishery, soon acquired a decided superiority over other nations, and towards the year 1680 employed in it about two hundred and sixty ships and fourteen thousand sailors. The Muscovy company was soon succeeded by another association no less fortunate. In 1725, the South sea company embarked largely in the trade, and prosecuted it for eight years, when, having lost a large sum, they gave it up. The legislature now resolved to support the trade: in 1732, a bounty of 20s. a ton was granted to ships engaged in it. In 1749, this was raised to 40s., when, observes Mr Macculloch, as many ships were fitted out for catching the bounty as for catching fish. In 1777, this bounty was reduced to 30s.; the consequence of which was, that during the next five years the number of ships employed in the trade was reduced from one hundred and five to thirty-nine! In 1781, the bounty was raised again to its old level; and an inducement being thus held out for making money in an easy but factitious way, the trade was soon restored to its apparent prosperous state. The American war now impeded the fisheries, and in 1787, 1792, and 1795, the bounty was again decreased; in 1824, it ceased altogether.

tremely timorous, they will soon be induced to quit those shores, where they meet such frequent disturbance and danger. The poor natives of Greenland themselves, who used to feed upon the whale, are diminishing, in proportion as their sustenance is removed; and it is probable that the revolution of a few years will see that extensive coast totally deserted by its inhabitants, as it is already nearly deserted by the whales. The art of taking whales, like most others, is much improved by time, and differs in many respects from that practised by the Biscayneers, when they first frequented the icy sea. But as the description of their method is the least complicated, and consequently the easiest understood, it will be best suited to our purpose.[1]

For this navigation, the Biscayneers, in favourable seasons, fitted out thirty ships, of two hundred and fifty tons each, with fifty choice men apiece, and a few boys. These were stored with six months' provision; and each ship had its boats, which were to be serviceable when come to the place of duty. When arrived at the part where the whales are expected to pass to the southward, they always keep their sails set, and a sailor is placed at the mast-head, to give information when he spies a whale. As soon as he discovers one, the whole crew are instantly in employment: they fit out their boats and row away to where the whale was seen. The harpooner, who is to strike the fish, stands at the prow of the boat, with a harpoon or javelin in

[1] The whale (says Scoresby, who has written from long personal observation on the subject) which is a mammiferous animal, and closely allied, in its anatomical structure, to the class of quadrupeds, affords in the modification of the parts and principles of land animals, for applying them to a tribe inhabiting the sea, a great number of those striking displays of wisdom and power, the very contemplation of which is calculated to elevate, in no inconsiderable degree, our conceptions of the Great Supreme. The mysticetus feeds on the smallest insects; its capacious mouth, with the vast fringes of whalebone, which is a most admirable filter, enables it to receive some tons of water at a mouthful, and to separate every substance from it, of the size of a pin's head and upwards. The physalis feeds on herrings, mackerel and other fishes of a similar kind; its whalebone therefore is shorter, stronger, and less compact than that of the mysticetus, and the filter formed by it less perfect.

As the whale must rise to the surface of the sea to breathe, its tail is placed horizontally, to enable it to ascend and descend more quickly; and its nostrils, or blowholes, instead of being placed at the snout, are generally on the most elevated part of the head, that they may be readily lifted clear of the water.

When the whale descends to the depths of the ocean, it becomes exposed to an enormous pressure from the superincumbent water. This pressure is sufficient to force the water through the pores of the hardest wood; yet it is effectually resisted by the skin of the whale, though it is remarkably soft and flexible. To exclude the water from the lungs, which would occasion suffocation if admitted, the blow-holes are defended by the peculiar valves that have been already described.

The variety discovered in the structure of whales, is by no means one of the least interesting parts of their physiology. In other classes of animals, whose habits are similar, we often find that each organ is the same as the corresponding one, in almost all the species of the same genus, or even of the same order; excepting when their peculiar habits, or necessities, require a modification of the general structure or principle. But in whales, as if it were intended not only to exhibit the matchless wisdom of the Creator, but to show that his resources are unlimited, the structure of the breathing canals is varied in the different genera of cetaceous animals, and a number of contrivances, alike extraordinary, equally beautiful, and equally efficient, are adapted for performing the same office.

The whale seems dull of hearing. A noise in the air, such as that produced by a person shouting, is not noticed by it, though at the distance only of a ship's length: but a very slight splashing in the water in calm weather excites its attention, and alarms it.

Its sense of seeing is acute; whales are observed to discover one another in clear water, when under the surface, at an amazing distance. When at the surface, however, they do not see far.

They have no voice; but in breathing or blowing they make a very loud noise. The vapour they discharge is ejected to the height of some yards, and appears at a distance like a puff of smoke. When the animals are wounded, it is often stained with blood; and, on the approach of death, jets of blood are sometimes discharged alone. They blow strongest, densest, and loudest, when "running." When in a state of alarm, or when they first appear at the surface, after being a long time down, they respire or blow about four or five times a minute.

The whale being somewhat lighter than the medium in which it swims, can remain at the surface of the sea, with its "crown," in which the blowholes are situated, and a considerable extent of the back, above water, without any effort or motion. To descend, however, requires an exertion. The proportion of the whale that appears above water, when alive, or when recently killed, is probably not a twentieth part of the animal; but within a day after death, when the process of putrefaction commences, the whale swells to an enormous size, until at least a third of the carcass appears above water, and sometimes the body is burst by the force of air generated within.

By means of the tail principally, the whale advances through the water. The greatest velocity is produced by powerful strokes against the water, impressed alternately upward and downward; but a slower motion, it is believed, is elegantly produced, by cutting the water laterally, and obliquely, downward, in a manner similar to that in which a boat is forced along, with a single oar, by the operation of skulling. The fins are generally stretched out in a horizontal position: their chief application seems to be the balancing of the animal, as the moment life is extinct, it always falls over on its side, or turns upon its back. They appear also to be used in bearing off their young, in turning, and giving a direction to the velocity produced by the tail.

Bulky as the whale is, and inactive, or indeed clumsy as it appears to be, one might imagine that all its motions would be sluggish, and its greatest exertions productive of but little celerity. The fact, however, is the reverse. A whale extended motionless at the surface of the sea, can sink in the space of five or six seconds, or less, beyond the reach of its human enemies. Its velocity along the surface, or perpendicularly, or obliquely downward, is the same. I have observed a whale descending after I had harpooned it, to the depth of 400 fathoms, with the average velocity of seven or eight miles per hour. The usual rate at which whales swim, however, even

his hand five or six feet long, pointed with steel like the barb of an arrow, of a triangular shape. As this person's place is that of the greatest dexterity, so also it is of the greatest danger: the whale sometimes overturns the boat with a blow of its tail; or drives against it with fury. In general, however, the animal seems to sleep on the surface of the water:

when they are on their passage from one situation to another, seldom exceeds four miles an hour; and though, when urged by the sight of an enemy, or alarmed by the stroke of a harpoon, their extreme velocity may be at the rate of eight or nine miles an hour, yet we find this speed never continues longer than for a few minutes, before it relaxes to almost one half; hence, for the space of a few minutes, they are capable of darting through the water with the velocity almost of the fastest ship under sail, and of ascending with such rapidity as to leap entirely out of the water. This feat they sometimes perform as an amusement apparently, to the high admiration of the distant spectators; but to the no small terror of the inexperienced fishers, who, even under such circumstances, are often ordered by the fool-hardy harpooner to "pull away" to the attack. Sometimes the whales throw themselves into a perpendicular posture, with their heads downwards, and rearing their tail on high in the air, beat the water with awful violence. In both these cases the sea is thrown into foam, and the air filled with vapours: the noise in calm weather is heard to a great distance; and the concentric waves, produced by the concussions on the water, are communicated abroad to a considerable extent. Sometimes the whale shakes its tremendous tail in the air, which, cracking like a whip, resounds to the distance of two or three miles.

When it retires from the surface, it first lifts its head, then plunging it under water, elevates its back, like the segment of a sphere, deliberately rounds it away towards the extremity, throws its tail out of the water, and then disappears.

In their usual conduct, whales remain at the surface to breathe, about two minutes, seldom longer; during which time they "blow" eight or nine times, and then descend for an interval usually of five or ten minutes, but sometimes, when feeding, fifteen or twenty. The depth to which they commonly descend is not known, though, from the eddy occasionally observed on the water, it is evidently at times only trifling. But when struck, the quantity of line they sometimes take out of the boats, in a perpendicular descent, affords a good measure of the depth. By this rule they have been known to descend to the depth of an English mile, and with such velocity, that instances have occurred, in which whales have been drawn up by the line attached, from the depth of 700 or 800 fathoms, and have been found to have broken their jaw-bones, and sometimes crown bone, by the blow struck against the bottom. Some persons are of opinion that whales can remain under a field of ice, or at the bottom of the sea in shallow water, when undisturbed, for many hours at a time. Whales are seldom found sleeping, yet in calm weather, among ice, instances occasionally occur.

The food of the whale consists of various species of actiniæ, cliones, sepiæ, medusæ, caneri, and helices, or, at least, some of these genera are always to be seen, wherever any tribe of whales is found stationary and feeding. In the dead animals, however, in the very few instances in which I have been enabled to open their stomachs, squillæ or shrimps were the only substances discovered. In the mouth of a whale just killed, I once found a quantity of the same kind of insect.

When the whale feeds, it swims with considerable velocity below the surface of the sea, with its jaws widely extended. A stream of water consequently enters its capacious mouth, and along with it large quantities of water insects; the water escapes again at the sides; but the food is entangled and sifted, as it were, by the whale-bone, which, from its compact arrangement, and the thick internal covering of hair, does not allow a particle the size of the smallest grain to escape.

There does not seem to be sufficient dissimilarity in the form and appearance of the mysticete found in the polar seas, to entitle them to a division into other species; yet such is the difference observed in the proportions of these animals, that they may be well considered as sub-species or varieties. In some of the mysticete, the head measures four-tenths of the whole length of the animal; in others, scarcely three-tenths; in some the circumference is upwards of seven-tenths of the length, in others less than six-tenths, or little more than one half.

The sexual intercourse of whales is often observed about the latter end of summer: and females with cubs or suckers along with them, being most commonly met with in the spring of the year, the time of their bringing forth, it is presumed, is in February or March, and their period of gestation about nine or ten months. In the latter end of April, 1811, a sucker was taken by a Hull whaler, to which the funis umbilicalis was still attached. The whale has one young at a birth. Instances of two being seen with a female are very rare. The young one, at the time of parturition, is said to be at least ten if not fourteen feet in length. It goes under the protection of its mother for probably a year or more, or until, by the evolution of the whalebone, it is enabled to procure its own nourishment. Supposing the criterion of the notches in the whalebone being indicative of the number of years' growth to be correct, then it would appear that the whale reaches the magnitude called *size*, that is, with a six feet length of whalebone, in twelve years, and attains its full growth at the age of twenty or twenty-five. Whales, doubtless, live to a great age. The marks of age are, increase in the quantity of gray colour in the skin, and a change to a yellowish tinge of the white parts about the head; a decrease in the quantity of oil yielded by a certain weight of blubber; an increase of hardness in the blubber, and in the thickness and strength of the ligamentous fibres of which it is partly composed.

The maternal affection of the whale, which, in other respects, is apparently a stupid animal, is striking and interesting; the cub, being insensible to danger, is easily harpooned; when the tender attachment of the mother is so manifested, as not unfrequently to bring her within the reach of the whalers. Hence, though a cub is of little value, seldom producing above a ton of oil, and often less, yet it is sometimes struck as a snare for its mother. In this case she joins it at the surface of the water, whenever it has occasion to rise for respiration; encourages it to swim off; assists its flight by taking it under her fin, and seldom deserts it while life remains. She is then dangerous to approach; but affords frequent opportunities for attack. She loses all regard for her own safety in anxiety for the preservation of her young: dashes through the midst of her enemies; despises the danger that threatens her; and even voluntarily remains with her offspring, after various attacks on herself from the harpoons of the fishers. In June, 1811, one of my harpooners struck a sucker, with the hope of its leading to the capture of the mother. Presently she arose close by the "fast boat," and seizing the young one, dragged about a hundred fathoms of line with remarkable force and velocity. Again she arose to the surface, darted furiously to and fro, frequently stopped short, or suddenly changed her direction, and gave every possible intimation of extreme agony. For a length of time she

while the boat is approaching, the harpooner stands aloft, and with his harpoon tied to a cord of several hundred fathoms length, darts it into the animal, and then rows as fast as possible away. It is some time before the whale seems to feel the blow; the instrument has usually pierced no deeper than the fat, and that being insensible, the animal continued thus to act, though closely pursued by the boats; and, inspired with courage and resolution by the concern for her offspring, seemed regardless of the danger which surrounded her. At length one of the boats approached so near that a harpoon was hove at her. It hit, but did not attach itself. A second harpoon was struck; this also failed to penetrate; but a third was more effectual, and held. Still she did not attempt to escape; but allowed other boats to approach; so that, in a few minutes, three more harpoons were fastened, and in the course of an hour afterward she was killed.

There is something extremely painful in the destruction of a whale, when thus evincing a degree of affectionate regard for its offspring, that would do honour to the superior intelligence of human beings; yet the object of the adventure, the value of the prize, the joy of the capture, cannot be sacrificed to feelings of compassion. Whales, though often found in great numbers together, can scarcely be said to be gregarious; found most generally solitary, or in pairs, excepting when drawn to the same spot by the attraction of an abundance of palatable food, or a choice situation of the ice.

The superiority of the sexes, in point of numbers, seems to be in favour of the male. Of 124 whales which have been taken near Spitzbergen, in eight years, in ships commanded by myself, 70 were males, and 54 were females, being in the proportion to five to four nearly. The mysticetus occurs most abundantly in the frozen seas of Greenland and Davis's Strait—in the bays of Baffin and Hudson—in the sea to the northward of Behring's Strait, and along some parts of the northern shores of Asia, and probably America. It is never met with in the German ocean, and rarely within 200 leagues of the British coast; but along the coasts of Africa and South America it is met with periodically in considerable numbers. In these regions it is attacked and captured by the southern British and American whalers, as well as by some of the people inhabiting the coasts, to the neighbourhood of which it resorts. Whether this whale is precisely of the same kind as that of Spitzbergen and Greenland, is uncertain, though it is evidently a mysticetus. One striking difference, possibly the effect of situation and climate, is, that the mysticetus found in southern regions is often covered with barnacles, (Lepas diadema, &c.) while those of the Arctic seas are free from these shell fish.

It would be remarkable if an animal like the whale, which is so timid that a bird alighting upon its back sometimes sets it off in great agitation and terror, should be wholly devoid of enemies. Besides man, who is doubtless its most formidable adversary, it is subject to annoyance from sharks, and it is also said from the narwhal, sword-fish, and thresher. With regard to the narwhal, I am persuaded that this opinion is incorrect, for so far from its being an enemy, it is found to associate with the whale in the greatest apparent harmony, and its appearance, indeed, in the Greenland sea is hailed by the fishers, the narwhal being considered as the harbinger of the whale. But the sword-fish and thresher (if such an animal there be) may possibly be among the enemies of the whale, notwithstanding I have never witnessed their combats; and the shark is known certainly to be an enemy, though perhaps not a very formidable one. Whales indeed flee the seas where it abounds, and evince by marks occasionally found on their tails, a strong evidence of their having been bit by the shark. A living whale may be annoyed, though it can scarcely be supposed to be ever overcome by the shark; but a dead whale is an easy prey, and affords a fine banquet to this insatiable creature.

The whale, from its vast bulk, and variety of products, is of great importance in commerce, as well as in the domestic economy of savage nations; and its oil and whalebone are of extensive application in the arts and manufactures.

Though to the refined palate of a modern European, the flesh of a whale, as an article of food, would be received with abhorrence, yet we find that it is considered by some of the inhabitants of the northern shores of Europe, Asia, and America, as well as those on the coasts of Hudson's Bay, and Davis's Strait, as a choice and staple article of subsistence. The Esquimaux eat the flesh and fat of the whale, and drink the oil with greediness. Indeed, some tribes, who are not familiarized with spirituous liquors, carry along with them in their canoes, in their fishing excursions, bladders filled with oil, which they use in the same way, and with a similar relish, that a British sailor does a dram. They also eat the skin of the whale raw, both adults and children; for it is not uncommon, when the females visit the whale-ships, for them to help themselves to pieces of skin, preferring those with which a little blubber is connected, and to give it as food to their infants suspended on their backs, who suck it with apparent delight.

Blubber, when pickled and boiled, is said to be very palatable; the tail, when parboiled, and then fried, is said to be not unsavoury, but even agreeable eating; and the flesh of young whales, I know from experiment, is by no means indifferent food.

Not only is it certain that the flesh of the whale is now eaten by savage nations, but it is also well authenticated that, in the 12th, 13th, 14th, and 15th centuries, it was used as food by the Icelanders, the Netherlanders, the French, the Spanish, and probably by the English. M. S. B. Noel, in a tract on the whale fishery, informs us that about the 13th century the flesh, particularly the tongue of the whales, was sold in the markets of Bayonne, Cibourre, and Beariz, where it was esteemed as a great delicacy, being used at the best tables; and even so late as the 15th century, he conceives, from the authority of Charles Etienne, that the principal nourishment of the poor in Lent, in some districts of France, consisted of the flesh and fat of the whale.

Besides forming a choice eatable, the inferior products of the whale are applied to other purposes by the Indian and Esquimaux of arctic countries, and with some nations are essential to their comfort; some membranes of the abdomen are used for an upper article of clothing, and the peritoneum, in particular, being thin and transparent, is used instead of glass in the windows of their huts; the bones are converted into harpoons and spears, for striking the seal, or darting at the sea-birds, and are also employed in the erection of their tents, and with some tribes, in the formation of their boats; the sinews are divided into filaments, and used as thread, with which they join the seams of their coats and tent cloths, and sew with great taste and nicety the different articles of dress they manufacture; and the whalebone and other superior products, so valuable in European markets, have also their uses among them.

I shall conclude this account of the mysticetus with a sketch of some of the characters which belong generally to cetaceous animals.

Whales are viviparous: they have but one young at a time, and suckle it with teats. They are furnished with lungs, and are under the necessity of approaching

tinues for a while motionless; but soon roused from its seeming lethargy, as the shaft continues to pierce deeper and deeper into the muscular flesh, it flies off with amazing rapidity. In the meantime, the harpoon sticks in its side, while the rope, which is coiled up in the boat, and runs upon a swivel, lengthens as the whale recedes, but still shows the part of the deep to which it has retreated. The cord is coiled up with great care; for such is the rapidity with which it runs off, that if it was but the least checked, as it yields with the animal's retreat, it would infallibly overset the boat, and the crew would go to the bottom. It sometimes happens also, that the rapidity with which it runs over the swivel at the edge of the boat, heats it, and it would infallibly take fire, did not a man stand continually with a wet mop in his hand, to cool the swivel as the cord runs.[1] The whale having dived to a considerable depth, remains at the bottom, sometimes for near half an hour, with the harpoon in its body, and then rises to take breath, expecting the danger over; but the instant it appears, they are all with their boats ready to receive it, and fling the harpoons into its body; the animal again dives and again rises, while they repeat their blows. The ship follows in full sail, like all the rest, never losing sight of the boats, and ready to lend them assistance; the whole ocean seems dyed in blood. Thus they renew their attacks, till the whale begins to be quite enfeebled and spent, when they plunge their longer spears into various parts of its body, and the enormous animal expires.[2] When it is dead, to prevent it from sinking, they tie it with a strong iron chain to the side of the boat, and either cut it up in pieces, and carry it home in that manner, or extract the oil from the blubber on ship-board.

Such is the manner in which these fish were taken in the beginning; but succeeding arts have improved the method, and the harpoon is now thrown by; a machine being used which inflicts a deeper wound, and strikes the animal with much greater certainty; there are better methods for extracting oil, and proper machines for cutting the animal up, than were used in the early fisheries. But as an account of this belongs to the history of art, and not of nature, we must be contented with observing, that several parts of this animal, and all but the intestines and the bones, are turned to a very good account; not only the oil, but the greaves from which it is separated. The barbs also were an article of great profit; but have sunk in their price since women no longer use them to swell out their petticoats with whalebone. The flesh of this animal is also a dainty to some nations, and even the French seamen are now and then found to dress and use it as their ordinary diet at sea. It is said, by the English and Dutch sailors, to be hard and ill-tasted; but the French assert the contrary; and the savages of Greenland, as well as those near the south pole, are fond of it to distraction. They eat the flesh, and drink the oil, which is a first-rate delicacy. The finding a dead whale is an adventure considered among the fortunate circumstances of their wretched lives.

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the surface of the water at intervals to respire in the air. The heart has two ventricles and two auricles. The blood is warmer than in the human species; in a narwhal that had been an hour and a half dead, the temperature of the blood was 97°; and in a mysticetus recently killed 102°. All of them inhabit the sea.—Some of them procure their food by means of a kind of sieve, composed of two fringes of whalebone; these have no teeth. Others have no whalebone, but are furnished with teeth. They all have two lateral or pectoral fins, with concealed bones like those of a hand; and a large flexible horizontal tail, which is the principal member of motion. Some have a kind of dorsal fin, which is an adipose or cartilaginous substance, without motion. This fin, varying in form, size, and position, in different species, and being in a conspicuous situation, is well adapted for a specific distinction. The appearance and dimensions of the whalebone and teeth, especially the former, are other specific characteristics. All whales have spiracles or blowholes, some with one, others with two openings, through which they breathe; some have a smooth skin all over the body; others have rugæ or sulci about the region of the thorax and on the lower jaw. And all afford beneath the integuments, a quantity of fat or blubber, from whence a useful and valuable oil, the train oil of commerce, is extracted.—*Scoresby.*

[1] It is also customary to have a man stationary with an axe, ready to cut the rope asunder should it become entangled.

[2] The extreme fidelity of these wonderful animals towards each other, and their affection for their offspring, is most incredible. So fondly attached are they to the society of their brethren, that many instances are recorded of their assuming a passive floating position, on the surface, after offering much resistance; as though disdaining to survive the loss of their companions. Thus, when the Cyrus had captured six, out of a herd of seven whales, and they were supported around the vessel on the water, the surviving one rose, and thrust its head amongst its dead brethren, and remained immovable, close to the vessel, while it was killed. In general, the female is accompanied in her progress by her young one, though, on the contrary, she sometimes wanders very far from it; and yet, by some unknown impulse, highly calculated to excite our amazement, she has no difficulty in finding it, though perfectly silent, in the vast and trackless ocean, as often as she requires; and the same may be said of all the cetacea. But further, when her young one is hardest pursued and harpooned, she supports it under her fin, while she plunges with it for safety into unfathomable depths. A young whale, having been struck by a harpoon from a Hull vessel, being at the time at some distance from its mother, had run out some length of line, when the latter appeared in sight, and rapidly bent her course towards it. In vain did she use every usual means to induce it to leave the place of danger, while swimming by its side, as far as the line would allow, in circles around the boats, during the space of four hours; and within this time, on four separate occasions, the parent was observed, when on

They make their abode beside it; and seldom remove till they have left nothing but the bones.

Jacobson, whom we quoted before in the History of Birds, where he described his countrymen of the island of Feroe as living a part of the year upon salted gulls, tells us also, that they are very fond of salted whale's flesh. The fat of the head they season with bay salt, and then hang it up to dry in the chimney. He thinks it tastes as well as fat bacon; and the lean, which they boil, is, in his opinion, not inferior to beef. I fancy poor Jacobson would make but an indifferent taster at one of our city feasts!

CHAP. IV.

OF THE NARWHAL.[1]

(See Plate XIV. fig. 20.)

From whales that entirely want teeth, we come to such as have them in the upper jaw only; and in this class is found but one, the Narwhal, or Sea-unicorn. This fish is not so large as the whale, not being above sixty feet long. Its body is slenderer than that of the whale, and its fat not in so great abundance. But this great animal is sufficiently distinguished from all others of the deep by its tooth, or teeth, which stand pointing directly forward from the upper jaw, and are from nine to fourteen feet long. In all the variety of weapons with which Nature has armed her various tribes, there is not one so large or so formidable as this. This terrible weapon is generally found single, and some are of opinion that the animal is furnished but with one by nature; but there is at present the skull of a narwhal at the Stadthouse at Amsterdam, with two teeth; which plainly proves that in some animals, at least, this instrument is double. It is even a doubt whether it may not be so in all; and that the narwhal's wanting a tooth is only an accident which it has met with in the encounters it is obliged daily to be engaged in. Yet it must be owned, of those that are taken only with one tooth, there seem no socket, nor no remains of any other upon the opposite side of the jaw, but all is plain and even. However this be, the tooth, or, as some are pleased to call it, the horn of the narwhal, is the most terrible of all natural instruments of destruction. It is as straight as an arrow, about the thickness of the small of a man's leg, wreathed in the manner we sometimes see twisted bars of

the surface, to throw one of her fins over the body of the young whale, and to endeavour to drag it away by all the force she possessed; she, lastly, in this way set off with it in a straight direction, carrying away additional line, to the extent of seven hundred and twenty fathoms; but by that time, the young one became so much exhausted from loss of blood, that she necessarily abandoned it to its fate, and herself escaped, by pursuing her progress towards the ice, roaring and spouting with great vehemence; for when a whale is struck with a harpoon, or is enraged by the loss of its young, it ejects the water through its spiracles with great force, producing a striduous kind of roaring, which may be heard the distance of a mile.

[1] The *Beluga* or *White Whale*. The general appearance of this very beautiful animal will be perceived from the following cut. A Beluga for nearly three months



during the summer of 1815 was observed to inhabit the Frith of Forth, passing upwards almost every day with the tide, and returning with the ebbing of the waters. During this time it was generally known under the name of the White Whale, and was supposed frequently to be in pursuit of salmon. Many fruitless attempts were made to secure it; but at length it was killed by the salmon-fishers, by means of spears and fire-arms. It was purchased by Mr Bald of Allos, and transmitted by him to Professor Jameson, and is now in the Royal museum at Edinburgh. It was examined by Drs Barclay and Neil, whose observations are published in *Trans. Wernerian Soc.* vol. iii.

The food of the Beluga is said to be cod, haddocks, flounders, and smaller fish of this description. It seeks them with perseverance, pursues them with ardour, and devours them with avidity. Its favourite haunts are evidently the higher latitudes of the Arctic regions. They are plentiful in Hudson's bay, Davis's straits, and on some parts of the northern coasts of Asia and America, where they frequent the large rivers. Steller mentions them as being found at Kamtschatka; and according to Charleroix, they are numerous in the Gulf of St Lawrence, and go with the tide as high as Quebec. There are fisheries both for them and the porpoise in that river. A considerable quantity of oil is obtained, and of their skins is made a sort of morocco leather, thin, yet strong enough to resist a musket-ball (*Pen. Art. Zool.* i. 183). They also abound near Disco island in Greenland, and are not uncommon in Spitzbergen. Mr Scorseby never observed them lower than Jan Mayen's land. This navigator also remarks, that he has seldom seen them among the ice, but in those places where the water is clearest and smoothest. They are not at all shy, but often follow the ships, and tumble about the boats in herds of thirty or forty; bespangling the surface with their splendid whiteness. They are seldom pursued by the whale fishers, not only because it is difficult to strike them, on account of their great activity; but because the harpoon often gives way; and they are, moreover, of comparatively little value when killed. It is only a few stragglers that are seen in the

iron; it tapers to a sharp point; and is whiter, heavier and harder, than ivory. It is generally seen to spring from the left side of the head directly forward in a straight line with the body; and its root enters into the socket above a foot and a half. In a skull to be seen at Hamburgh there are two teeth, which are each above seven feet long, and are eight inches in circumference. When the animal, possessed of these formidable weapons, is urged to employ them, it drives directly forward against the enemy with its teeth, that, like protended spears, pierce whatever stands before them.

The extreme length of these instruments has induced some to consider them rather as horns than teeth; but they in every respect resemble the tusks of the boar and the elephant. They grow, as in them, from sockets in the upper jaw; they have the solidity of the hardest bone, and far surpass ivory in all its qualities. The same error has led others to suppose, that as among quadrupeds the female was often found without horns, so these instruments of defence were only to be found in the male: but this has been more than once refuted by actual experience; both sexes are found armed in this manner; the horn is sometimes found wreathed, and sometimes smooth; sometimes a little bent, and sometimes straight; but always strong, deeply fixed, and sharply pointed.

Yet, notwithstanding all these appointments for combat, these long and pointed tusks, amazing strength, and unmatchable celerity, the narwhal is one of the most harmless and peaceful inhabitants of the ocean. It is seen constantly and inoffensively sporting among the other great monsters of the deep, no way attempting to injure them, but pleased in their company. The Greenlanders call the narwhal the forerunner of the whale; for wherever it is seen, the whale is shortly after sure to follow. This may arise as well from the natural passion for society in these animals, as from both living upon the same food, which are the insects described in the preceding chapter. These powerful fishes make war upon no other living creature; and though furnished with instruments to spread general destruction, are as innocent and as peaceful as a drove of oxen. Nay, so regardless are they of their own weapons, and so utterly unmindful to keep them in repair for engagement, that they are constantly seen covered over with weeds, slough, and all the filth of the sea; they seem rather considered as an impediment than a defence.

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southern latitudes, or even on the European shores. Besides the one mentioned above, Colonel Imrie, in 1793, saw two young ones which had been cast upon the beach in the Pentland Frith, some miles to the east of Thurso. They were both males, between seven and eight feet long; they were white, mottled with brownish-gray.

The *Deductor* or *Ca'ing Whale*. Egede is perhaps the first author who makes mention of the Deductor,



under the name of Butshead (*Descrip. of Greenland*, 75); and he was soon followed by Duhamel, who gave a figure of one taken at Havre, under the name of "the porpoise with the round snout." In 1806, Dr Neil, in an appendix to his "Tour through some of the islands of Orkney and Shetland," gives a more extended and interesting account of them, under the name of Uyea-Sound or Ca'ing Whales, than any which had previously appeared; and three years after, Dr Trail published in Nicolson's Journal (1809) the first accurate description of this species, giving it the appellation of *Delphinus Melas*, with a drawing from his friend James Watson, Esq., which was republished, with additional details, by Scoresby in his "Arctic regions, 1830." In 1812, an interesting memoir concerning this variety, named by him Globiceps, appeared from the pen of Cuvier, in vol. xix. *Ann. du Museum*. From these sources, some interesting circumstances may be detailed of this species.

It would appear that the Northern ocean, from the 56° to the 66°, is the favourite resort of the Deductor. Sometimes it has been witnessed in lower latitudes; but not frequently, nor in large numbers: it would also seem to have been seen in the Mediterranean, but whether as a mere straggler or a permanent residenter, we cannot decidely affirm. Of all the cetacea, this would appear to be the most sociable, often herding together in innumerable flocks. We shall here supply a few facts which establish this point. From an old history of the Feroe islands, quoted by Scoresby, it would appear that the inhabitants are in the habit of hunting these animals, which they designate *Grind Whales*, and capture them in great numbers. In the year 1664, on two excursions only, they killed about one thousand. In the year 1748, forty individuals of this species were seen in Tor bay, and one seventeen feet long was captured; in 1799, about two hundred ran ashore in Fetlar, one of the Shetland isles; and in 1805, as mentioned by Dr Neil, in February, one hundred and ninety, and in March, one hundred and twenty more, out of a herd of about five hundred, were forced ashore on the same spot in Uyea-Sound in Unst. In 1806, ninety-two were stranded in Scalpa bay, Orkney: in the winter of 1809 and 1810, eleven hundred and ten of these whales approached the shore of Hvalfiord, Iceland, and were captured: in 1812, seventy were chased ashore near the village of Bloubalzbance, on the coast of Bretagne; and in 1814, one hundred and fifty were driven into Balta sound, Shetland, and were there despatched. These are only a few of the instances, in which, in modern times, an extensive slaughter of the Deductor has taken place.—*Naturalist's Lib., by Sir. W. Jardine.*

The manners and appetites both of the narwhal and the great whale are entirely similar; they both alike want teeth for chewing, and are obliged to live upon insects; they both are peaceable and harmless, and always rather fly than seek the combat. The narwhal, however, has a much narrower gape than the great whale, and, therefore, does not want the use of barbs to keep in its food when once sucked into the mouth. It is also much swifter, and would never be taken by the fishermen but for those very tusks which at first appear to be its principal defence. These animals, as was said, being fond of living together, are always seen in herds of several hundreds at a time; and whenever they are attacked they crowd together in such a manner, that they are mutually embarrassed by their tusks. By these they are often locked together, and are prevented from sinking to the bottom. It seldom happens, therefore, but the fishermen make sure of one or two of the hindmost, which very well reward their trouble.[1]

It is from the extraordinary circumstance of the teeth, therefore, that this fish demands a distinct history; and such has been the curiosity of mankind, and their desire to procure them, that a century ago they were considered as the greatest rarity in the world. At that time the art of catching whales was not known; and mankind saw few, except such as were stranded on the coasts by accident. The tooth of the narwhal, therefore, was ascribed to a very different animal from that which really bore it. Among other fossil substances, they were sometimes dug up; and the narwhal being utterly unknown, naturalists soon found a terrestrial owner. They were thought to be the horns of unicorns, an animal described by Pliny as resembling a horse, and with one straight horn darting forward from the middle of its forehead. These teeth were, therefore, considered as a strong testimony in favour of that historian's veracity, and were shown among the most precious remains of antiquity. Even for some time after the narwhal was known, the deceit was continued, as those who were possessed of a tooth sold it to great advantage. But at present they are too well known to deceive any, and are only shown for what they really are; their curiosity increasing in proportion to their weight and size.

[1] The blubber of the narwhal produces very fine oil; but it is chiefly hunted for its tusk, which forms ivory of a quality superior to that of the elephant.

CHAP. V.

OF THE CACHALOT, AND ITS VARIETIES.[2]

(*For Great Headed Cachalot, see Plate XIV. fig.* 24.)

The Cachalot which has generally gone under the name of the spermaceti-whale, till

[2] The *Spermaceti Cachalot* is found in greatest abundance in the Pacific ocean, where large numbers of them



are annually killed by the American and other whalers for the sake of their oil and spermaceti. The spermaceti cachalot is gregarious, and herds are frequently seen containing two hundred or more individuals. Such herds, with the exception of two or three old males, are composed of females, who appear to be under the direction of the males. The males are distinguished by the whalers as *bulls;* the females they call *cows*. The bulls attack with great violence, and inflict dreadful injuries upon other males of the species which attempt to join their herd. These animals live separately, while young, according to their age and sex. The young and half grown males are found by themselves; the old *cows* protect the young females. When the young bulls attain sufficient strength, they venture into a herd under the protection of some old bulls, an intrusion that is said to produce a severe contest, by which they succeed in gaining admittance to, or are driven from the herd.

The mode of attacking these animals is as follows:—Whenever a number of them are seen, four boats, each provided with two or three lines, two harpoons, four lances, and a crew of six men, proceed in pursuit, and, if possible, each boat strikes or "fastens to" a distinct animal, and each crew kill their own. When engaged in distant pursuit, the harpooner generally steers the boat, and in such cases the proper boat steerer occasionally strikes, but the harpooner mostly kills it. If one cachalot of a herd is struck, it commonly takes the lead and is followed by the rest. The one which is struck seldom descends far under water, but generally swims off with great rapidity, stopping after a short course, so that the boat can be drawn up to it by the line, or be rowed sufficiently near to lance it. In the agonies of death, the struggles of the animal are truly tremendous, and the surface of the ocean is lashed into foam by the motions of the fins and tail. Tall jets of blood are discharged from the blowholes, which show that the wounds have taken mortal effect, and seeing this, the boats are kept aloof, lest they should be dashed to pieces by the violent efforts of the victim.

When a herd is attacked in this way, ten or twelve of the number are killed; those which are only wounded are rarely captured. After the cachalot is killed, the

Mr Pennant very properly made the distinction, by borrowing its name from the French, has several teeth in the under jaw, but none in the upper. As there are no less than seven distinctions among whales, so also there are the same number of distinctions in the tribe we are describing. The cachalot with two fins and a black back; the cachalot with two fins and a whitish back; that with a spout in the neck; that with a spout in the snout; that with three fins and sharp-pointed teeth; that with three fins and sharp-edged teeth; and, lastly, the cachalot, with three fins and flatted teeth.

This tribe is not of such enormous size as the whale, properly so called, not being above sixty feet long, and sixteen feet high. In consequence of their being more slender, they are much more active than the common whale; they remain a longer time at the bottom; and afford a smaller quantity of oil. As in the common whale the head was seen to make a third part of its bulk, so in this species the head is so large as to make one half of the whole. The tongue of this animal is small, but the throat is very formidable; and with very great ease it could swallow an ox. In the stomach of the whale scarcely any thing is to be found; but in that of the cachalot there are loads of fish of different kinds; some whole, some half digested, some small, and others eight or nine feet long. The cachalot is, therefore, as destructive among lesser fishes, as the whale is harmless; and can at one gulp swallow a shoal of fishes down its enormous gullet.—Linnæus tells us that this fish pursues and terrifies the dolphins and porpoises so much, as often to drive them on shore.

But, how formidable soever this fish may be to its fellows of the deep, it is by far the most valuable, and the most sought after by man, as it contains two very precious drugs, spermaceti and ambergris. The use of these, either for the purposes of luxury or medicine, is so universal, that the capture of this animal, that alone supplies them, turns out to very great advantage, particularly since the art has been found out of converting all the oil of this animal, as well as the brain, into that substance called spermaceti.

This substance, as it is naturally formed, is found in the head of the animal, and is no other than the brain. The outward skin of the head being taken off, a covering of fat offers about three inches thick; and under that, instead of a bony skull, the animal has only another thick skin that serves for a covering and defence of the brain. The first cavity or chamber of the brain, is filled with that spermaceti which is supposed of the greatest purity and highest value. From this cavity there is generally drawn about seven barrels of the clearest spermaceti, that thrown upon water coagulates like cheese. Below this there is another chamber just over the gullet, which is about seven feet high; and this also contains the drug, but of less value. It is distributed in this cavity like honey in a hive, in small cells, separated from each other by a membrane like the inner skin of an egg. In proportion as the oily substance is drawn away from this part, it fills anew from every part of the body; and from this is generally obtained about nine barrels of oil. Besides this, the spinal-marrow, which is as thick as a man's thigh, and reaches all along the backbone to the tail, where it is not thicker than one's finger, affords no inconsiderable quantity.[1]

This substance, which is used in the composition of many medicines, rather to give them consistence than efficacy, was at first sold at a very high price, both from the many virtues ascribed to it, and the small quantity that the cachalot was capable of supplying:

boats tow it to the side of the ship, and if the weather be fine, and other objects of chase in view, they are again sent to the attack.

The separation of the blubber from the animal, or "flensing," is sometimes done differently from the manner used in the polar whaling. A strap of blubber is cut in a spiral direction, and being raised by tackles, turns the cachalot round as on an axis, until nearly all the blubber is stripped off. The material contained within the head, consisting of spermaceti mixed with oil, being in a fluid state while warm, is taken out of large cachalots in buckets, while the animal remains in the water; but in smaller ones, the part of the head containing the spermaceti, is hoisted upon deck before the cavity is opened.

The substances taken from the head, congealing as soon as cold, the compound is thrown in its crude state into casks, and is purified at the end of the voyage on shore. The oil is reduced from the blubber shortly after it is on board, in "try works," with which the ships engaged in this business are always provided. There are two coppers in the try works, placed side by side, near the fore hatch. These, with their furnaces and casing of brickwork, occupy a space of five or six feet in length, by eight or nine in breadth, (or fore and aft—and athwart ship,) and four or five feet in height. The cavity of the brick arches sustaining the coppers and furnaces, forms a water cistern, so that while the fire is burning, the deck is secured from injury by the changing of the water in the cistern twice or thrice in every watch. As the oil is extracted it is thrown into coolers, whence, after about twenty-four hours, it is transferred to casks. At first the coppers are heated with wood, but afterward the cracklings or fritters of the blubber, which still contain some oil, are employed as fuel, and produce a fierce fire. About three tons of oil are commonly obtained from a large cachalot of this species; from one to two tons are procured from a small one. A cargo, produced from one hundred cachalots, may be from 150 to 200 tons of oil, besides the spermaceti, &c.

[1] The perfume called Ambergris, is found in large masses in the intestines, and is now known to be nothing more than the excrements of the animal.

at present, the price is greatly fallen; first, because its efficacy in medicine is found to be very small: and again, because the whole oil of the fish is easily convertable into spermaceti. This is performed by boiling it with a ley of pot-ash, and hardening it in the manner of soap. Candles are now made of it, which are substituted for wax, and sold much cheaper; so that we need not fear having our spermaceti adulterated in the manner some medical books caution us to beware of; for they carefully guard us against having our spermaceti adulterated with virgin wax.

As to the ambergris, which is sometimes found in this whale, it was long considered as a substance found floating on the surface of the sea; but time, that reveals the secrets of the mercenary, has discovered that it chiefly belongs to this animal. The name, which has been improperly given to the former substance, seems more justly to belong to this; for the ambergris is found in the place where the seminal vessels are usually situated in other animals. It is found in a bag of three or four feet long, in round lumps from one to twenty pounds weight, floating in a fluid rather thinner than oil, and of a yellowish colour. There are never seen more than four at a time in one of these bags; and that which weighed twenty pounds, and which was the largest ever seen, was found single. These balls of ambergris are not found in all fishes of this kind, but chiefly in the oldest and strongest. The uses of this medicine for the purposes of luxury, and as a perfume, are well known; though upon some subjects ignorance is preferable to information.

CHAP. VI.

OF THE DOLPHIN, THE GRAMPUS AND THE PORPOISE, WITH THEIR VARIETIES.

All these fish have teeth both in the upper and the lower jaw, and are much less than the whale. The Grampus, which is the largest, never exceeds twenty feet. It may also be distinguished by the flatness of its head, which resembles a boat turned upside down. The Porpoise resembles the grampus in most things except the snout, which is not above eight feet long; its snout also more resembles that of a hog. The Dolphin has a strong resemblance to the porpoise, except that its snout is longer, and more pointed. They have all fins on the back; they all have heads very large, like the rest of the whale-kind; and resemble each other in their appetites, their manners, and conformations; being equally voracious, active, and roving.[1]

The great agility of these animals prevents their often being taken. They seldom remain

[1] The Dolphin tribe of cetaceous fishes comprehends about thirteen species, eleven with the dorsal fin, and the others without. *Soosoo* is the name which the Bengalese about Calcutta give to a species of dolphin found in the Ganges, especially in the slow-moving labyrinth of rivers and creeks which intersect the Delta of that river to the south, south-east and east of Calcutta. The description of this new species we owe to Dr Roxburgh, who distinguishes it by the name of *Delphinus Gangeticus*. Its body (including the head) is long and slender, thickest about the forepart, and from thence tapering to the tail; from the anus forward nearly round. The skin is soft, smooth, and of a shining pearl-gray when dry, with here and there light-coloured spots or clouds, particularly when old. When the animal is alive, and seen in the act of rising to breathe, it appears much darker. The length of the individual which Dr Roxburgh examined (and which was young, little more than half grown,) was six and a half feet, and at the thickest part, which is rather behind the pectoral fins, three feet in circumference. The weight 120 pounds. For *Delphinus Phocæna*, or Porpoise, see Plate XIV. fig. 22.

The *Common Dolphin*. This animal is perhaps better



known as the fictitious creature of unrestrained imagination and of heroic poetry, than the sober Goose of the sea. It is uniformly considered as the dolphin of antiquity; the original whence were produced those fantastic beings, endowed with all those extraordinary attributes and charms with which it was clothed. It is the *Hieros Ichthys*, or Sacred Fish of the Greeks, to which they originally paid divine honours, and which they afterwards embellished with all the illusions of unbridled fancy. It was also sacred to their god Apollo; the reason assigned for which is, that when Apollo appeared to the Cretans, and obliged them to settle on the coasts of Delphis, where he founded that oracle so famous throughout antiquity, he did so under the form of a dolphin. Apollo was thus, according to Visconti, adored not only in connection with the Delphin province, but the Delphinus fish. He was worshipped at Delphi with dolphins for his symbols. The ancients respected the dolphin as a benefactor of mankind; they cherished the tale of Phalantus, the founder of Tarentum, being carried on shore by a dolphin when wrecked on the coast of Italy; and the story of the musician Arion, who, when about to be thrown overboard by the sailors that they might possess themselves of his wealth, begged that he might be permitted to play some melodious tune, and then throw himself into the sea; upon which one of the many Dolphins, which had been attracted by the music, carried him on its back safe to Tenarus; or rather, perhaps, according to Ovid,

> Secure he sits, and with harmonious strains
> Requites his bearer for his friendly pains.

It is also recorded that the shield and sword of Ulysses

a moment above water; sometimes, indeed, their too eager pursuits expose them to danger; and a shoal of herrings often allures them out of their depth. In such a case, the hungry animal continues to flounder in the shallows till knocked on the head, or till the returning tide seasonably comes to its relief. But all this tribe, and the dolphin in particular, are not less swift than destructive. No fish could escape them, but from the awkward position of the mouth, which is placed in a manner under the head: yet, even with these disadvantages, their depredations are so great, that they have been justly styled the plunderers of the deep.

What could induce the ancients to a predilection in favour of these animals, particularly the dolphin, it is not easy to account for. Historians and philosophers seem to have contended who should invent the greatest number of fables concerning them. The dolphin was celebrated in the earliest time for its fondness to the human race, and was distinguished by the epithets of the boy-loving and philanthropist. Scarcely an accident could happen at sea, but the dolphin offered himself to convoy the unfortunate to shore. The musician flung into the sea by pirates, the boy taking an airing in the midst of the sea, and returning again in safety, were obliged to the dolphin for its services. It is not easy, I say, to assign a cause why the ancients should thus have invented so many fables in their favour. The figure of these animals is far from prejudicing us in their interest; their extreme rapacity tends still less to endear them; I know nothing that can reconcile them to man and excite his prejudices, except that when taken they sometimes have a plaintive moan, with which they continue to express their pain till they expire. This, at first, might have excited human pity; and that might have produced affection. At present, these fishes are regarded even by the vulgar in a very different light; their appearance is far from being esteemed a favourable omen by the seamen; and from their boundings, springs, and frolics in the water, experience has taught the mariners to prepare for a storm.

But it is not to one circumstance only that the ancients have confined their fabulous re-

bore an image of the dolphin, and it is certain it is seen in very ancient medals and coins. It very early appeared on the shield of some of the princes of France; it gave a name to a fair province of that empire, and hence a title to the heir-apparent of the crown.

Scarcely less fabulous are those other narratives which have been transmitted on the testimony of the early naturalists. They tell us that the dolphin made itself familiar with man, and conceived a warm attachment for him. Pliny narrates that in Barbary, near the town of Hippo, a dolphin used to frequent the shore, and accept of food from any hand which supplied it; it would mix among those who were bathing, would allow them to mount its back, would consign itself with docility to their direction, and obey them with as much celerity as precision (lib. ix. chap. 48). Still more extraordinary is that other tale the ancients relate in illustration of the assertion that the dolphin was yet more partial to children than to adults. Thus, according to Pliny, in several chronicles it was recorded that a dolphin which had penetrated the lake of Lucrinus, in Campania, every day received bread from the hand of a child, answering to his call, and transporting him on its back to school to the other side of the lake. This intimacy continued for several years, when the boy dying, the affectionate dolphin, overwhelmed with grief, soon sunk under its bereavement. For such stories as these, which might be easily multiplied from Herodotus, Plutarch, &c., we apprehend that most of our readers will have but little patience; and we therefore dismiss them with the well known apophthegm,

Sed quid non Grecia mendax
Audet in historia?

The common dolphin is usually six or seven feet long, sometimes nine or ten. Its proportions on the whole are pleasing, and admirably adapted for swimming. The pectoral fin is oval and placed very low; the tail is large and powerful. Its tints, though not gay, are attractive. It is black on the back, grayish on the flanks, and white underneath, with a peculiar and satiny glistening when in, or newly taken out of the water, which is striking and beautiful. It may be well, however, here to remark, that "the dolphin with its many dying colours" mentioned in many books, and sung by modern poets, is not this, but quite another animal, belonging to a different class of the animal kingdom; it is a true fish, the beautifully coloured *Coryphæna Hippuris*, the Dorado of the Portuguese.

The common dolphin is an inhabitant of the European seas, of the Atlantic, and Mediterranean. It is more common in the temperate zone than in places that are further south. It is true that other species of this genus frequent the seas of Africa, Asia, and America; but it is by no means satisfactorily ascertained that the species now under consideration has this extensive range. The opposite opinion seems to be much more probable. They navigate the waters of the ocean in more or less numerous troops, and their vigorous springs and rapid natation, which is daily observed by voyagers, has long made them famous. The common dolphin has long been peculiarly signalized for these qualities, which however it enjoys only in common with the larger number of its congeners, and on these points it does not merit any particular distinctions. To swim with the rapidity of an arrow, to shoot ahead of vessels which are scudding before the breeze, to spring out of the water, and over the waves, are qualifications possessed alike by all the smaller cetacea which live in troops in the ocean.

Pernetty's Dolphin.—On the 30th of October the vessel of Bougainville, in which Pernetty sailed, being near the Cape-de-Verd islands, was surrounded by about a hundred dolphins, which approached very near them. "They appeared," says Pernetty, "to have come only for the purpose of amusing us; they made extraordinary leaps out of the water; many of these in their capering vaulted four feet high, and turned over two or three times in the air."

One of these dolphins which was taken, weighed a hundred pounds; its beak was slender, and covered with a thick and grayish skin. "I think," says the author, "it was of that species which is named the *Monk of the Sea*, for the anterior part of the head ter-

ports concerning these animals; as from their leaps out of their element, they assume a temporary curvature, which is by no means their natural figure in the water, the old painters and sculptors have universally drawn them wrong. A dolphin is scarcely ever exhibited by the ancients in a straight shape, but curved, in the position which they sometimes appear in when exerting their force; and the poets too have adopted the general error. Even Pliny, the best naturalist, has asserted, that they instantly die when taken out of the water; but Rondelet, on the contrary, assures us that he has seen a dolphin carried alive from Montpelier to Lyons.

The moderns have more just notions of these animals; and have got over the many fables, which every day's experience contradicts. Indeed their numbers are so great, and, though shy, they are so often taken, that such peculiarities, if they were possessed of any, would have been long since ascertained. They are found, the porpoise especially, in such vast numbers, in all parts of the sea that surrounds this kingdom, that they are sometimes noxious to seamen, when they sail in small vessels. In some places they almost darken the water as they rise to take breath, and particularly before bad weather, are much agitated, swimming against the wind, and tumbling about with unusual violence.

Whether these motions be the gambols of pleasure or the agitations of terror, is not well known. It is most probable that they dread those seasons of turbulence, when the lesser fishes shrink to the bottom, and their prey no longer offers in such abundance. In times of fairer weather they are seen herding together, and pursuing shoals of various fish with great impetuosity. Their method of hunting their game, if it may be so called, is to follow in a pack, and thus give each other mutual assistance. At that season, when the mackarel, the herring, the salmon, and other fish of passage begin to make their appearance, the cetaceous tribes are seen fierce in the pursuit; urging their prey from one creek or bay to another, deterring them from the shallows, driving them towards each other's ambush, and using a greater variety of arts than hounds are seen to exert in pursuing the hare. However, the porpoise not only seeks for prey near the surface, but often descends to the bottom in search of sand-eels, and sea-worms, which it roots out of the sand with its nose, in the manner hogs harrow up the fields for food. For this purpose, the nose projects a little, is shorter and stronger than that of the dolphin; and the neck is furnished with very strong muscles, which enable it the readier to turn up the sand.

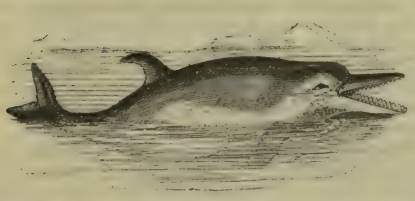
But it sometimes happens, that the impetuosity, or the hunger, of these animals, in their usual pursuits, urges them beyond the limits of safety. The fishermen, who extend their long nets for pilchards, on the coasts of Cornwall, have sometimes an unwelcome capture in one of these.—Their feeble nets, which are calculated only for taking smaller prey, suffer a universal laceration from the efforts of this strong animal to escape; and if it be not knocked on the head, before it has had time to flounder, the nets are destroyed, and the fishery interrupted. There is nothing, therefore, they so much dread, as the entangling a porpoise; and they do every thing to intimidate the animal from approaching.[1]

Indeed, these creatures are so violent in the pursuit of their prey, that they sometimes follow a shoal of small fishes up a fresh-water river, from whence they find no small difficulty to return. We have often seen them taken in the Thames at London, both above the bridges and below them. It is curious enough to observe with what activity they avoid their pursuers, and what little time they require to fetch breath above the water. The manner of killing them is for four or five boats to spread over the part of the river in which they are seen, and with fire-arms to shoot at them the instant they rise above the water. The fish being thus for some time kept in agitation, requires to come to the surface at quicker intervals, and thus affords the marksmen more frequent opportunities.

When the porpoise is taken, it becomes no

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minated in a hood near the root of the muzzle, and



there presented something like the edge of a cloak; the back was black, and the abdomen of a pearly-gray colour, verging to yellowish, dappled with spots, some black and others of an iron-gray colour: the teeth were sharp, white, and in the form of those of the pike." To these peculiar characters, Pernetty adds those which are common to all the genus, and subjoins one which, we believe, is often referred to many of them, viz. that they exhale an odour which is so strong and penetrating, that whatever substance is impregnated with it, retains it for many days, in spite of all that can be done to overcome it.

[1] During a scarcity of fish, porpoises are said to dive to the bottom, and root, like hogs, among the sand, for sand-eels and sea-worms. Hence in most languages they receive the name of sea-hogs. Porpoise has that signification in the Italian.

inconsiderable capture, as it yields a very large quantity of oil; and the lean of some, particularly if the animal be young, is said to be as well tasted as veal. The inhabitants of Norway prepare, from the eggs found in the body of this fish, a kind of cavier, which is said to be a very delicate sauce, or good when even eaten with bread. There is a fishery for porpoise along the western isles of Scotland during the summer season, when they abound on that shore; and this branch of industry turns to good advantage.

As for the rest, we are told, that these animals go with young ten months; that, like the whale, they seldom bring forth above one at a time, and that in the midst of summer: that they live to a considerable age; though some say not above twenty-five or thirty years; and they sleep with the snout above water. They seem to possess, in a degree proportioned to their bulk, the manners of whales; and the history of one species of cetaceous animals, will, in a great measure, serve for all the rest.

A

HISTORY OF FISHES.

BOOK II.

OF CARTILAGINOUS FISHES.

CHAP. I.

OF CARTILAGINOUS FISHES IN GENERAL.

We have seen that fishes of the cetaceous kind bear a strong resemblance to quadrupeds in their conformation; those of the cartilaginous kinds are one remove separated from them; they form the shade that completes the imperceptible gradations of nature.

The first great distinction they exhibit is, in having cartilages or gristles instead of bones. The cetaceous tribes have their bones entirely resembling those of quadrupeds, thick, white, and filled with marrow; those of the spinous kind, on the contrary, have small slender bones, with points resembling thorns, and generally solid throughout. Fishes of the cartilaginous kinds have their bones always soft and yielding; and age, that hardens the bones of other animals, rather contributes still more to soften theirs. The size of all fishes increases with age; but from the pliancy of the bones in this tribe, they seem to have no bounds placed to their dimensions; and it is supposed that they grow larger every day till they die.

They have other differences, more obviously discernible. We have observed, that the cetaceous tribes had lungs like quadrupeds, a heart with its partition in the same manner, and an apparatus for hearing; on the other hand, we mentioned that the spinous kinds had no organs of hearing, no lungs to breathe through, and no partition in the heart; but that their cold red blood was circulated by the means of the impulse made upon their gills by the water. Cartilaginous fishes unite both these systems in their conformation: like the cetaceous tribes, they have organs of hearing, and lungs; like the spinous kinds, they have gills, and a heart without a partition. Thus possessed of a twofold power of breathing, sometimes by means of their lungs, sometimes by that of their gills, they seem to unite all the advantages of which their situation is capable, and drawing from both elements every aid to their necessities or their enjoyments.

This double capacity of breathing in these animals, is one of the most remarkable features in the history of Nature. The apertures by which they breathe, are somewhere placed about the head; either beneath, as in flat fish; on the sides, as in sharks; or the top of the head, as in pipe-fish. To these apertures are the gills affixed, but without any bone to open and shut them, as in spinous fishes; from which, by this mark, they may be easily distinguished, though otherwise very much alike in appearance. From these are bending cylindrical ducts, that run to the lungs, and are supposed to convey the air, that gives the organs their proper play. The heart, however, has but one valve; so that their blood wants that double circulation which obtains in the cetaceous kinds; and the lungs seem to be rather as an internal assistant to the gills, than fitted for supplying the same offices as in quadrupeds, for they want the pulmonary vein and artery.

From this structure, however, the animal is enabled to live a longer time out of water than those whose gills are more simple. The cartilaginous shark, or ray, live some hours after they are taken; while the spinous herring or mackarel expire a few minutes after they are brought on shore. From hence this tribe seems possessed of powers that other fishes are wholly deprived of; they can remain continually under water, without ever taking breath; while they can venture their heads above the deep, and continue for hours out of their native element.

We observed, in a former chapter, that

spinous fishes have not, or at least appear not to have, externally any instruments of generation. It is very different with those of the cartilaginous kind, for the male always has these instruments double. The fish of this tribe are not unfrequently seen to copulate; and their manner is belly to belly, such as may naturally be expected from animals whose parts of generation are placed forward. They in general choose colder seasons and situations than other fish for propagating their kind; and many of them bring forth in the midst of winter.

The same duplicity of character which marks their general conformation, obtains also with regard to their manner of bringing forth. Some bring forth their young alive; and some bring forth eggs, which are afterwards brought to maturity. In all, however, the manner of gestation is nearly the same; for upon dissection, it is ever found, that the young, while in the body, continue in the egg till a very little time before they are excluded: these eggs they may properly be said to hatch within their body; and as soon as their young quit the shell, they begin to quit the womb also. Unlike to quadrupeds, or the cetaceous tribes, that quit the egg state in a few days after their first conception, and continue in the womb several months after, these continue in the body of the female, in their egg state, for weeks together; and the eggs are found linked together by a membrane, from which, when the fœtus gets free, it continues but a very short time till it delivers itself from its confinement in the womb. The eggs themselves consist of a white and a yolk, and have a substance instead of shell, that aptly may be compared to softened horn. These, as I observed, are sometimes hatched in the womb, as in the shark and ray kinds; and they are sometimes excluded, as in the sturgeon, before the animal comes to its time of disengaging. Thus we see that there seems very little difference between the viviparous and the oviparous kinds, in this class of fishes: the one hatch their eggs in the womb, and the young continue no long time there; the others exclude their eggs before hatching, and leave it to time and accident to bring their young to maturity.

Such are the peculiar marks of the cartilaginous class of fishes, of which there are many kinds. To give a distinct description of every fish is as little my intention, as perhaps it is the wish of the reader; but the peculiarities of each kind deserve notice, and the most striking of these it would be unpardonable to omit.

Cartilaginous fish may be divided first into those of the shark kind, with a body growing less towards the tail, a rough skin, with the mouth placed far beneath the end of the nose, five apertures on the sides of the neck for breathing, and the upper part of the tail longer than the lower. This class chiefly comprehends the Great White Shark, the Balance Fish, the Hound Fish, the Monk Fish, the Dog Fish, the Basking Shark, the Zygæna, the Tope, the Cat Fish, the Blue Shark, the Sea Fox, the Smooth Hound Fish, and the Porbeagle. These are all of the same nature, and differ more in size, than in figure or conformation.

The next division is that of flat fish; and these their broad, flat, thin shape, is sufficiently capable of distinguishing from all others of this kind. They may be easily distinguished also from spinous flat fish, by the holes through which they breathe, which are uncovered by a bone; and which, in this kind, are five on each side. In this tribe we may place the Torpedo, the Skate, the Sharp-nosed Ray, the Rough Ray, the Thornback, and the Fire Flare.

The third division is that of the slender snake-shaped kind; such as the Lamprey, the Pride, and the Pipe-fish.

The fourth division is that of the Sturgeon and its variety, the Ising-glass Fish.

The last division may comprise fish of different figures and natures, that do not rank under the former divisions. These are the Sun-Fish, the Tetrodon, the Lump Fish, the Sea Snail, the Chimæra, and the Fishing Frog. Each of these has somewhat peculiar in its powers or its forms, that deserves to be remarked. The description of the figures of these at least may compensate for our general ignorance of the rest of their history.

CHAP. II.

OF CARTILAGINOUS FISHES OF THE SHARK KIND.[1]

Of all the inhabitants of the deep, those of the shark kind are the fiercest and the most

[1] About thirty species of sharks have been distinguished, of which twelve have been seen on the British coasts. Some, from pursuing their prey in concert, are called sea-dogs, hounds, and beagles. We may here particularize the Blue Shark, the Basking Shark, and the Angel Shark.

The *Blue Shark*.—The back of this shark is blue; the belly white. No orifices are to be seen behind the eye, as is usual with fish of this genus. Two white membranes, one to each eye, perform the office of eyelids. When the head was placed downwards, a pretty large white pouch came out of its mouth. Ælian supposed this to serve as an asylum for the young in time of danger; and Mr Pennant, who gives credit to the story, thinks that this fish, like the opossum, may have

voracious. The smallest of this tribe is not less dreaded by greater fish, than many that to appearance seem more powerful; nor do any of them seem fearful of attacking animals far above their size; but the Great White Shark, which is the largest of the kind, joins to the most amazing rapidity, the strongest appetites for mischief: as he approaches nearly in size to the whale, he far surpasses him in strength and celerity, in the formidable arrangement of his teeth, and his insatiable desire of plunder.

The *White Shark* is sometimes seen to rank even among whales for magnitude; and is



found from twenty to thirty feet long. Some assert that they have seen them of four

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a place fitted by nature for the reception of her young. This, however, has been denied by some writers.

The *Basking Shark*.—This, though a very large fish, possesses none of the voracity and ferociousness that mark the generality of the shark tribe. It will frequently

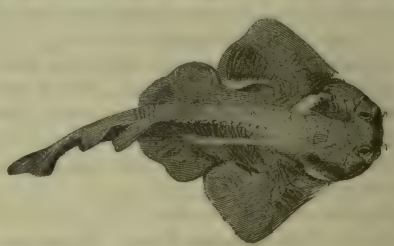


lie motionless on the surface of the water, generally on its belly, but sometimes on its back; and it seems so little afraid of mankind as often to suffer itself to be patted and stroked. Its body is slender, and from three to twelve yards in length; of a deep lead colour above, and white below. The upper jaw is blunt at the end, and much longer than the lower. The mouth is placed beneath, and furnished with small teeth; these before much bent, and the remote ones conical and sharp-pointed. On each side of the neck are five breathing apertures. There are two dorsal, two pectoral, two ventral fins, and one small anal fin. Within the mouth, near the throat, is a short kind of whale-bone. The liver is of such an immense size as frequently to weigh near a thousand pounds. From this a great quantity of good oil is extracted, which renders this shark an animal of considerable importance to the Scotch fishermen; for according to Anderson, the oil of a single fish will sometimes sell for twenty or thirty pounds sterling. The basking shark (which derives its name from its propensity to lie on the surface of the water, as if to bask itself in the sun) frequents our seas during the warm summer months, and is not uncommon on the Welch and Scottish coasts, where they come in shoals, usually after intervals of a certain number of years. In the intervening summers, those that are seen upon the Welch coast are generally single fish, that have probably strayed from the rest. They appear in the frith of Clyde, and among the Hebrides, about midsummer, in small droves of seven or eight, or more commonly in pairs. Here they continue till the latter end of July, when they disappear. The food of these sharks seems to consist entirely of marine plants, and some of the species of medusæ. They swim very deliberately, and generally with their upper fins above water. Sometimes they may be seen sporting about amongst the waves, and leaping several feet above the surface. The natives of our northern coasts are very alert in the pursuit, and very dexterous in the killing of those fish. When pursued, they do not accelerate their motion till the boat comes almost in contact with them, when the harpooner strikes his weapon into the body as near the gills as he can. They seem not very susceptible of pain; for they often remain in the same place till the united strength of two men is exerted to force the harpoon deeper. As soon as they perceive themselves wounded, they plunge headlong to the bottom, and frequently coil the rope round their bodies in agony, attempting to disengage themselves from the fatal instrument by rolling on the ground. Discovering that these efforts are in vain, they swim off with such amazing rapidity, that one instance has occurred of a basking shark towing to some distance, a vessel of seventy tons burden against a fresh gale. They sometimes run off with two hundred fathoms of line, and two harpoons in them; and will employ the men from twelve

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to twenty-four hours before they are subdued. As soon as they are killed, the fishermen haul them on shore; or, if at a distance from land, to the vessel's side, to cut them up and take out the liver, which is the only useful part of their bodies. This is melted into oil in kettles provided for the purpose; and if the fish be a large one, it yields eight barrels or upwards.

The *Angel-shark*.—This is very unlike the common sharks, being distinguished by its flat body, which forms



the connecting link, as it were, between the genus of rays and that of sharks, as it partakes of the figure of both. It is called Angel-shark from its extended pectoral fins having the appearance of wings. The head is of a circular form, and rather broader than the body. The mouth is wide, and is situated at the extremity of the head. Like the sharks, the old fish of this species have more teeth than the young ones. Thus two angel-sharks, only a foot long, in the possession of Dr Block, had only two rows of teeth in the upper jaw, and three in the lower; while Willoughby and Rondelet assert, that there are three in the former, and five in the latter. Of a certain portion of the skin the Turks make the most beautiful shagreen for watch cases. The angel-shark is found in the Mediterranean and German ocean.

The *Spotted Dog-fish* is an inhabitant of most seas, and measures four feet long; it is very voracious, and feeds chiefly upon fish. The body is reddish brown, with large distinct black spots; it is white beneath, and a little compressed at each end: the skin, when dried, is used for various purposes. The head is small, and the snout short; the eyes are oblong, and the pupil is of a sea-green colour; the iris of the eye is white; the mouth is oblong, and wide, armed with three rows of teeth; the tongue is cartilaginous, and with the palate is rough; the nostrils are surrounded with a lobe and vermiform appendage; the vent is placed before the middle of the

thousand pound weight; and we are told particularly of one, that had a human corpse in his belly. The head is large and somewhat flatted; the snout long, and the eyes large. The mouth is enormously wide, as is the throat, and capable of swallowing a man with great ease. But its furniture of teeth is still more terrible; of these there are six rows, extremely hard, sharp-pointed, and of a wedge-like figure. It is asserted that there are seventy-two in each jaw, which make a hundred and forty-four in the whole; yet others think that their number is uncertain; and that in proportion as the animal grows older, these terrible instruments of destruction are found to increase. With these the jaws, both above and below, appear planted all over; but the animal has a power of erecting or depressing them at pleasure. When the shark is at rest, they lie quite flat in his mouth; but when he prepares to seize his prey, he erects all this dreadful apparatus, by the help of a set of muscles that join them to the jaw; and the animal he seizes, dies, pierced with a hundred wounds, in a moment.

Nor is this fish less terrible to behold as to the rest of his form: his fins are larger in proportion; he is furnished with great goggle eyes, that he turns with ease on every side, so as to see his prey behind him as well as before; and his whole aspect is marked with a character of malignity: his skin also is rough, hard and prickly; being that substance which covers instrument cases, called shagreen.

As the shark is thus formidable in his appearance, so is he also dreadful from his courage and activity. No fish can swim so fast as he; none so constantly employed in swimming; he outstrips the swiftest ships, plays round them, darts out before them, returns, seems to gaze at the passengers, and all the while does not seem to exhibit the smallest symptom of an effort to proceed. Such amazing powers, with such great appetites for destruction, would quickly unpeople even the ocean, but providentially, the shark's upper jaw projects so far above the lower, that he is obliged to turn on one side, (not on his back, as is generally supposed,) to seize his prey. As this takes some small time to perform, the animal pursued seizes that opportunity to make its escape.

Still, however, the depredations he commits are frequent and formidable. The shark is the dread of sailors in all hot climates; where, like a greedy robber, he attends the ships, in expection of what may drop over-board. A man who unfortunately falls into the sea at such a time, is sure to perish, without mercy. A sailor that was bathing in the Mediterranean, near Antibes, in the year 1744, while he was swimming about fifty yards from the ship, perceived a monstrous fish making towards him, and surveying him on every side, as fish are often seen to look round a bait. The poor man, struck with terror at its approach, cried out to his companions in the vessel to take him on board. They accordingly threw him a rope with the utmost expedition, and were drawing him up by the ship's side, when the shark darted after him from the deep, and snapped off his leg.

Mr Pennant tells us, that the master of a Guinea-ship, finding a rage for suicide prevail among his slaves, from a notion the unhappy creatures had, that after death they should be restored again to their families, friends, and country; to convince them at least that some disgrace should attend them here, he ordered one of their dead bodies to be tied by the heels to a rope, and so let down into the sea; and, though it was drawn up again with great swiftness, yet in that short space, the sharks had bit off all but the feet. Whether this story is prior to an accident of the same kind, which happened at Belfast in Ireland, about twenty years ago, I will not take upon me to determine; but certain it is, there are some circumstances alike in both, though more terrible in that I am going to relate. A Guinea captain was, by stress of weather, driven into the harbour of Belfast, with a lading of very sickly slaves, who, in the manner above-mentioned, took every opportunity to throw themselves overboard when brought up upon the deck, as usual, for the benefit of the fresh air. The captain perceiving, among others, a woman slave attempting to drown herself, pitched upon her as a proper example to the rest. As he supposed that they did not know the terrors attending death, he ordered the woman to be tied with a rope under the arm-pits, and so let her down into the water. When the poor creature was thus plunged in, and about half way down, she was heard to give a terrible shriek, which at first was ascribed to her fears of drowning: but soon after, the water appearing red all round her, she was drawn up, and it was found that a shark, which had followed the ship, had bit her off from the middle.

Such is the frightful rapacity of this animal; nothing that has life is rejected. But it seems to have a peculiar enmity to man: when once it has tasted human flesh, it never desists from haunting those places where it expects the return of its prey. It is even asserted, that along the coasts of Africa,

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body, the ventral fins distinct; the first dorsal fin is placed behind the ventral; the second dorsal fin is less, and nearly opposite the anal; the tail is narrow, ending below in a sharp angle.

where these animals are found in great abundance, numbers of the negroes, who are obliged to frequent the waters, are seized and devoured by them every year. The people of these coasts are firmly of opinion, that the shark loves the black man's flesh in preference to the white, and that when men of different colours are in the water together, it always makes choice of the former.

However this be, men of all colours are equally afraid of this animal, and have contrived different methods to destroy him. In general, they derive their success from the shark's own rapacity. The usual method of our sailors to take him, is by baiting a great hook with a piece of beef or pork, which is thrown out into the sea by a strong cord, strengthened near the hook with an iron chain. Without this precaution, the shark would quickly bite the cord in two, and thus set himself free. It is no unpleasant amusement to observe this voracious animal coming up to survey the bait, particularly when not pressed by hunger. He approaches it, examines it, swims round it, seems for a while to neglect it, perhaps apprehensive of the cord and chain; he quits it for a little; but his appetite pressing, he returns again; appears preparing to devour it, but quits it once more. When the sailors have sufficiently diverted themselves with his different evolutions, they then make a pretence, by drawing the rope, as if intending to take the bait away: it is then that the glutton's hunger excites him; he darts at the bait, and swallows it, hook and all. Sometimes, however, he does not so entirely gorge the whole, but that he once more gets free; yet even then, though wounded and bleeding with the hook, he will again pursue the bait until he is taken. When he finds the hook lodged in his maw, his utmost efforts are then excited but in vain, to get free; he tries with his teeth to cut the chain; he pulls with all his force to break the line; he almost seems to turn his stomach inside out, to disgorge the hook: in this manner he continues his formidable though fruitless efforts; till, quite spent, he suffers his head to be drawn above water, and the sailors, confining his tail by a noose, in this manner draw him on ship-board, and despatch him. This is done by beating him on the head till he dies; yet even that is not effected without difficulty and danger; the enormous creature, terrible even in the agonies of death, still struggles with his destroyers; nor is there an animal in the world that is harder to be killed. Even when cut in pieces, the muscles still preserve their motion, and vibrate for some minutes after being separated from the body. Another method of taking them, is by striking a barbed instrument, called a fizgig, into his body, as he brushes along by the side of the ship. As soon as he is taken up, to prevent his flouncing, they cut off the tail with an axe, with the utmost expedition.

This is the manner in which Europeans destroy the shark; but some of the Negroes along the African coast, take a bolder and more dangerous method to combat their terrible enemy. Armed with nothing more than a knife, the Negro plunges into the water, where he sees the shark watching for his prey, and boldly swims forward to meet him: though the great animal does not come to provoke the combat, he does not avoid it, and suffers the man to approach him; but just as he turns upon his side to seize the aggressor, the Negro watches the opportunity, plunges his knife into the fish's belly, and pursues his blows with such success, that he lays the ravenous tyrant dead at the bottom: he soon however returns, fixes the fish's head in a noose, and drags him to shore, where he makes a noble feast for the adjacent villages.

Nor is man alone the only enemy this fish has to fear: the Remora, or Sucking-fish, is probably a still greater, and follows the shark every where. This fish has got a power of adhering to whatever it sticks against, in the same manner as a cupping-glass sticks to the human body. It is by such an apparatus that this animal sticks to the shark, and drains away its moisture. The seamen, however, are of opinion, that it is seen to attend on the shark for more friendly purposes, to point him to his prey, and to apprise him of his danger. For this reason it has been called the Shark's Pilot.

The shark so much resembles the whale in size, that some have injudiciously ranked it in the class of cetaceous fishes; but its real rank is in the place here assigned it, among those of the cartilaginous kind. It breathes with gills and lungs, its bones are gristly, and it brings forth several living young. Belonius assures us, that he saw a female shark produce eleven live young ones at a time. But I will not take upon me to vouch for the veracity of Rondeletius, who, when talking of the blue shark, says, that the female will permit her small brood, when in danger, to swim down her mouth, and take shelter in her belly. Mr Pennant, indeed seems to give credit to the story, and thinks that this fish, like the oppossum, may have a place fitted by nature for the reception of her young. To his opinion much deference is due, and is sufficient, at least, to make us suspend our dissent; for nothing is so contemptible as that affectation of wisdom which some display, by universal incredulity.[1]

[1] Sharks, as well as the Ray tribe, bring forth their

Upon the whole, a shark, when living, is a very formidable animal; and, when dead, is of very little value. The flesh is hardly digestible by any but the Negroes, who are fond of it to distraction; the liver affords three or four quarts of oil; some imaginary virtues have been ascribed to the brain; and its skin is, by great labour, polished into that substance called shagreen. Mr Pennant is of opinion, that the female is larger than the male in all this tribe; which would, if confirmed by experience, make a striking agreement between them and birds of prey. It were to be wished that succeeding historians would examine into this observation, which is offered only as a conjecture![1]

CHAP. III.

OF CARTILAGINOUS FLAT-FISH, OR THE RAY KIND.

The same rapacity which impels the shark along the surface of the water, actuates the flat fish at the bottom. Less active, and less formidable, they creep in security along the bottom, seize every thing that comes in their way; neither the hardest shells nor the sharpest spines give protection to the animals that bear them; their insatiable hunger is such, that they devour all; and the force of their stomach is so great, that it easily digests them.

The whole of this kind resemble each other very strongly in their figure; nor is it easy, without experience, to distinguish one from another. The stranger to this dangerous tribe may imagine he is only handling a skate, when he is instantly struck numb by the torpedo; he may suppose he has caught a thornback, till he is stung by the fire-flare. It will be proper, therefore, after describing the general figure of these animals, to mark their differences.

All fish of the ray kind are broad, cartilaginous, swimming flat on the water, and having spines on different parts of their body, or at the tail. They all have their eyes and mouth placed quite under the body, with apertures for breathing either about or near them. They all have teeth, or a rough bone, which answers the same purpose. Their bowels are very wide towards the mouth, and go on diminishing to the tail. The tail is very differently shaped from that of other fishes; and at first sight more resembling that of a quadruped, being narrow, and ending either in a bunch or a point. But what they are chiefly distinguished by, is, their spines or prickles, which the different species have on different parts of their body. Some are armed with spines both above and below; others have them on the upper part only; some have their spines at the tail; some have three rows of them, and others but one. These prickles in some are comparatively soft and feeble; those of others, strong and piercing. The smallest of these spines are usually inclining towards the tail; the larger towards the head.

It is by the spines that these animals are distinguished from each other. The skate has the middle of the back rough, and a single row of spines on the tail. The sharp-nosed ray has ten spines that are situated towards the middle of the back. The rough ray has its spines spread indiscriminately over the whole back. The thorn-back has its spines disposed in three rows upon the back. The fire-flare has but one spine, but that indeed a terrible one. This dangerous weapon is placed on the tail, about four inches from the body, and is not less than five inches long. It is of a flinty hardness, the sides thin, sharp-pointed, and closely and sharply bearded the whole way. The last of this tribe that I shall mention is the torpedo; and this animal has no spines that can wound; but in the place of them it is possessed of one of the most potent and extraordinary faculties in nature.

Such are the principal differences that may enable us to distinguish animals, some of which are of very great use to mankind, from

young alive, more than one at a time, and each inclosed in a square horny case, terminated at the four corners by slender filaments. After being in the water some time, these natural pouches open at one end, and the young fish escapes from his confinement. These receptacles are, in the shark, of a pellucid horn-colour, terminated at the corners by very long slender filaments, which are generally found twisted round coral, sea-weeds, and other substances, to prevent their being driven on shore before the young is excluded: those of the Ray tribe are black, with the filaments hardly longer than the case, and are frequently cast on our shores in great abundance.

[1] The *Small Spotted Dog-Fish* is a species of shark, sometimes found on our shores. It is called *Morgay* in Scotland. It lies near the bottom of the water, and its



food is small fish and crustacea. It is often caught on the fishermen's lines, but is a useless capture to them. It is injurious to the fisheries from its voracity. Its length is about eighteen inches.

The *Large Spotted Dog-Fish*, called in Scotland *Bounce*, is easily distinguished from the other by its larger but less numerous spots, and by the greater bulk of the body for the same length. Like the Small Spotted Dog-Fish, its haunts are near the bottom, and its food similar, but it also frequents rocky ground, and is hence sometimes called the *Rock Dog-Fish*.

others that are terrible and noxious. With respect to their uses, indeed, as we shall soon see, they differ much; but the similitude among them, as to their nature, appetites, and conformation, is perfect and entire. They are all as voracious as they are plenty; and as dangerous to a stranger, as useful to him who can distinguish their differences.

Of all the larger fish of the sea, these are the most numerous; and they owe their numbers to their size. Except the white shark and cachalot alone, there is no other fish that has a swallow large enough to take them in; and their spines make them a still more dangerous morsel. Yet the size of some is such, that even the shark himself is unable to devour them; we have seen some of them in England weigh above two hundred pounds; but that is nothing to their enormous bulk in other parts of the world. Labat tells us of a prodigious ray that was speared by the Negroes at Guadaloupe, which was thirteen feet eight inches broad, and above ten feet from the snout to the insertion of the tail. The tail itself was in proportion, for it was no less than fifteen feet long, twenty inches broad at its insertion, and tapering to a point. The body was two feet in depth; the skin as thick as leather, and marked with spots; which spots, in all of this kind, are only glands, that supply a mucus to lubricate and soften the skin. This enormous fish was utterly unfit to be eaten by Europeans; but the Negroes chose out some of the nicest bits, and carefully salted them up as a most favourite provision.

Yet, large as this may seem, it is very probable that we have seen only the smallest of the kind; as they generally keep at the bottom, the largest of the kind are seldom seen; and as they may probably have been growing for ages, the extent of their magnitude is unknown. It is generally supposed, however, that they are the largest inhabitants of the deep; and, were we to credit the Norway bishop, there are some above a mile over. But to suppose an animal of such a magnitude is absurd; yet the overstretching the supposition does not destroy the probability that animals of this tribe grow to an enormous size.

The ray generally chooses for its retreat such parts of the sea as have a black muddy bottom; the large ones keep at greater depths; but the smaller approach the shores, and feed upon whatever living animals they can surprise, or whatever putrid substances they meet with. As they are ravenous, they easily take the bait, yet will not touch it if it be taken up and kept a day or two out of water. Almost all fish appear much more delicate with regard to a baited hook than their ordinary food. They appear by their manner to perceive the line, and to dread it; but the impulse of their hunger is too great for their caution; and, even though they perceive the danger, if thoroughly hungry they devour the destruction.

These fish generate in March and April; at which time only they are seen swimming near the surface of the water, several of the males pursuing one female. They adhere so fast together in coition, that the fishermen frequently draw up both together, though only one has been hooked. The females are prolific to an extreme degree; there having been no less than three hundred eggs taken out of the body of a single ray. These eggs are covered with a tough horny substance, which they acquire in the womb; for before they descend into that, they are attached to the ovary pretty much in the same manner as in the body of a pullet. From this ovary, or egg-bag, as it is vulgarly called, the fish's eggs drop one by one into the womb, and there receive a shell by the concretion of the fluids of that organ. When come to proper maturity, they are excluded, but never above one or two at a time, and often at intervals of three or four hours. These eggs, or purses, as the fishermen call them, are usually cast about the beginning of May, and they continue casting during the whole summer. In October, when their breeding ceases, they are exceedingly poor and thin; but in November they begin to improve, and grow gradually better till May, when they are in the highest perfection.

It is chiefly during the winter season that our fishermen take them; but the Dutch, who are indefatigable, begin their operations earlier, and fish with better success than we. The method practised by the fishermen of Scarborough is thought to be the best among the English; and, as Mr Pennant has given a very succinct account of it, I will take leave to present it to the reader.

"When they go out to fish, each person is provided with three lines: each man's lines are fairly coiled upon a flat oblong piece of wicker-work; the hooks being baited and placed very regularly in the centre of the coil. Each line is furnished with two hundred and eighty hooks, at the distance of six feet two inches from each other. The hooks are fastened to lines of twisted horse-hair, twenty-seven inches in length.

"When fishing, there are always three men in each coble; and consequently nine of these lines are fastened together, and used as one line, extending in length near three miles, and furnished with above two thousand five hundred hooks. An anchor and a buoy are fixed at the first end of the line, and one more at each end of each man's lines; in all, four anchors, and four buoys made of leather or

cork. The line is always laid across the current. The tides of flood and ebb continue an equal time upon our coast; and, when undisturbed by winds, run each way about six hours. They are so rapid that the fishermen can only shoot and haul their lines at the turn of the tide; and therefore the lines always remain upon the ground about six hours. The same rapidity of tide prevents their using hand lines; and, therefore, two of the people commonly wrap themselves in the sail and sleep, while the other keeps a strict look-out, for fear of being run down by ships, and to observe the weather; for storms often rise so suddenly, that it is sometimes with extreme difficulty they escape to the shore, though they leave their lines behind them.

"The coble is twenty feet six inches long, and five feet extreme breadth. It is about one ton burden, rowed with three pair of oars, and admirably constructed for the purpose of encountering a mountainous sea. They hoist sail when the wind suits.

"The five-men-boat is forty feet long, fifteen broad, and twenty-five tons burden. It is so called, though navigated by six men and a boy; because one of the men is hired to cook, and does not share in the profits with the other five.—All our able fishermen go in these boats to the herring fishery at Yarmouth, the latter end of September, and return about the middle of November. The boats are then laid up until the beginning of Lent, at which time they go off in them to the edge of the Dogger, and other places, to fish for turbot, cod, ling, skate, &c. They always take two cobles on board, and when they come upon their ground, anchor the boat, throw out the cobles, and fish in the same manner as those do who go from the shore in a coble; with this difference only, that here each man is provided with double the quantity of lines, and, instead of waiting the return of the tide in the coble, return to the boat, and bait their other lines; thus hauling one set, and shooting another, every turn of tide. They commonly run into the harbour twice a-week, to deliver their fish. The five-men-boat is decked at each end, but open in the middle, and has two long sails.

"The best bait for all kinds of fish, is fresh herring cut in pieces of a proper size: and notwithstanding what has been said to the contrary, they are taken there at any time in the winter, and all the spring, whenever the fishermen put down some nets for that purpose: the five-men-boats always take some nets for that end. Next to herrings are the lesser lampreys, which come all winter by land-carriage from Tadcaster. The next baits in esteem are small haddocks cut in pieces, sand-worms, muscles, and limpets; and, lastly, when none of these can be found, they use bullock's liver. The hooks used there are much smaller than those employed at Iceland and Newfoundland. Experience has shown that the larger fish will take a living small one upon the hook, sooner than any bait that can be put on; therefore they use such as the fish can swallow. The hooks are two inches and a half long in the shank; and near an inch wide between the shank and the point. The line is made of small cording, and is always tanned before it is used. All the rays and turbots are extremely delicate in their choice of baits: if a piece of herring or haddock has been twelve hours out of the sea, and then used as a bait, they will not touch it."

Such is the manner of fishing for those fish that usually keep near the bottom on the coasts of England; and Duhamel observes, that the best weather for succeeding, is a half-calm, when the waves are just curled with a silent breeze.

But this extent of line, which runs, as we have seen, three miles along the bottom, is nothing to what the Italians throw out in the Mediterranean. Their fishing is carried on in a tartan, which is a vessel much larger than ours; and they bait a line of no less than twenty miles long, with above ten or twelve thousand hooks. This line is called the *parasina:* and the fishing goes by that of the *pielago.* This line is not regularly drawn every six hours, as with us, but remains for some time in the sea, and it requires the space of twenty-four hours to take it up. By this apparatus they take rays, sharks, and other fish; some of which are above a thousand pounds weight. When they have caught any of this magnitude, they strike them through with a harpoon to bring them on board, and kill them as fast as they can.

This method of catching fish is obviously fatiguing, and dangerous; but the value of the capture generally repays the pains. The skate and the thornback are very good food, and their size, which is from ten pounds to two hundred weight, very well rewards the trouble of fishing for them. But it sometimes happens that the lines are visited by very unwelcome intruders; by the rough ray, the fire-flare, or the torpedo. To all these the fishermen have the most mortal antipathy; and, when discovered, shudder at the sight: however, they are not always so much upon their guard, but that they sometimes feel the different resentments of this angry tribe: and, instead of a prize, find they have caught a vindictive enemy. When such is the case, they take care to throw them back into the sea with the swiftest expedition.

The rough ray inflicts but slight wounds with the prickles with which its whole body

is furnished. To the ignorant it seems harmless, and a man would at first sight venture to take it in his hand, without any apprehension; but he soon finds, that there is not a single part of its body that is not armed with spines; and that there is no way of seizing the animal but by the little fin at the end of the tail.

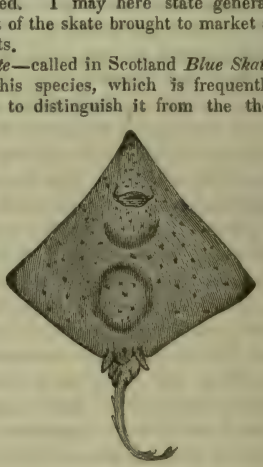
But this animal is harmless, when compared to the fire-flare, which seems to be the dread of even the boldest and most experienced fishermen.[1] The weapon with which nature has armed this animal, which grows from the tail, and which we described as barbed, and five inches long, hath been an instrument of terror to the ancient fishermen

[1] The Rays, or Skate, as they are popularly called, are remarkable for the rhomboidal form and consequent breadth of their bodies, contrasted with their long narrow tails, frequently furnished with two and sometimes three small fins, and mostly armed with one or more rows of sharp spines along the whole length. The whole body is very much depressed; the great breadth of it is produced by the expansion of what are considered as the pectoral fins, the base of each of which is equal to the whole length of the side of the fish. The Skate may almost be considered as having no true head or neck, the sides of both being included and thus protected by the expanded anterior margin of each pectoral fin. The nostrils, mouth, branchial and anal apertures, are on the under surface; the eyes and temporal orifices on the upper surface. The texture of the skin of the body varies considerably, and will be referred to when describing the different species. From the peculiar form of the body, admirably adapted to exist at the bottom of the water, the skate may with more propriety be called a Flatfish than any species of the *Pleuronectidæ*. Their mode of progression is not very easily described: it is, when they are not alarmed, performed with a slight motion of the pectoral fins, something between a slide and a swim. I once heard a North-country fisherman call it sluddering. When a skate makes the best of its way either to gain a prize in the matter of food, or to escape an enemy, great muscular exertion is evident. The mode of defending itself, as described by Mr Couch, is very effectual: the point of the nose and the base of the tail are bent upwards toward each other; the upper surface of the body being then concave, the tail is lashed about in all directions over it and the rows of sharp spines frequently inflict severe wounds.

Eight species of true Rays are found on the coasts of this country, four of which have the snout more or less elongated and sharp, and four have blunt noses, two of the latter being furnished with numerous sharp spines on various parts of the surface of the body. The skate, as food, are held in very different degrees of estimation in different places. In London, particularly, large quantities are consumed, and the flesh is considered delicate and well-flavoured; but on some parts of the coast, though caught in considerable numbers, both by lines and nets, the flesh is seldom devoted to any purpose beyond that of baiting pots for catching crabs and lobsters. Skate are in the best condition for the table during autumn and winter. In spring, and in the early part of summer, they are usually maturing eggs or young, and their flesh is then soft and woolly.

The *Long Nosed Skate* is immediately distinguished from any other skate found on the British coast, not only by the great length of the nose, but also by the distance between its most extreme point and the transverse line of the mouth; characters particularly observable in comparison with the species next in order, with which it most assimilates in colour. The snout is very much produced, narrow and sharp, slender as far as the eyes, from whence the body dilates gradually to its greatest breadth, which is behind the centre; the whole length of the body and tail one-third longer than the width. On the upper surface the body is slightly roughened, and of a light lead colour; the tail rather more rough, with a row of large crooked spines on each side of the central line, and this species is observed never to have more or less than these two lateral rows; the small fins on the tail not far removed from each other, the second about its own length from the end. The under surface is a dirty grayish white, marked with dusky specks like the true skate, but the body is thinner in substance than either that or the sharp-nosed skate: the nostrils are lobed; the mouth narrow; the teeth in old males sharp, with frequently nine or ten spines above the eyes; on the snout two rows of minute tubercular spines; behind the head seven or eight spines ranged in a line along the dorsal ridge; towards the outer upper edge of the pectoral fins on each side are the usual rows of sharp hooked spines, and close to the tail the long pendant claspers. By some of the West-country fishermen this species is called the Dun Cow: it attains considerable size, and is said to feed on sand-eels and sand-launce. According to Mr Couch, it frequents deep water, and is not caught through the winter: fishermen state that it is exceedingly violent when hooked. I may here state generally, that the greater part of the skate brought to market are taken in the trawlnets.

The *Skate*—called in Scotland *Blue Skate*, and *Gray Skate*. This species, which is frequently called the *True Skate* to distinguish it from the thornback and



homelyn, which are also popularly called skate, is not so commonly taken as either, but is still better than either as an article of food. It appears to be found among the Orkneys, and on the coasts of Scotland, where it is called blue skate and gray skate. From thence southward as far as Kent, and again westward to Cornwall, it is found along the whole line of coast. In Ireland, the skate is taken from Cork up the east coast to Antrim, and from thence northward and westward to Londonderry and Donegal. At Lyme Regis, on account of its dusky gray colour, it is called the tinker.

In this species both sexes when adult have sharp teeth, the points beginning to elongate by the time the body of the fish has attained the breadth of twelve or fourteen inches. The females are generally called maids; and fishermen distinguish the females of the three species of most frequent occurrence by the names of skate maid, thornback maid, and homelyn maid,—frequently calling the old male of the skate with his two long appendages the three-tailed skate. In each of these species the females are observed to be much more numerous as well as larger than the males. Pennant mentions having seen a skate

as well as the modern: and they have delivered many tremendous fables of its astonishing effects. Pliny, Ælian, and Oppian, have supplied it with a venom that affects even the inanimate creation: trees that are struck by it instantly lose their verdure, and rocks themselves are incapable of resisting the potent poison. The enchantress Circe armed her son with a spear headed with the spine of the trygon, as the most irresistible weapon she could furnish him with; a weapon that soon after was to be the death of his own father.

"That spears and darts," says Mr Pennant, "might in very early times have been headed with this bone instead of iron, we have no doubt. The Americans head their arrows with the bones of fishes to this day; and, from their hardness and sharpness, they are no contemptible weapons. But that this spine is possessed of those venomous qualities ascribed to it, we have every reason to doubt; though some men of high reputation, and the whole body of fishermen, contend for its venomous effects. It is, in fact, a weapon of offence belonging to this animal, and capable, from its barbs, of inflicting a very terrible wound, attended with dangerous symptoms; but it cannot be possessed of any poison, as the spine has no sheath to preserve the sup-

that weighed two hundred pounds: it is very voracious, and Mr Couch has known five different species of fish, besides crustacea, taken from the stomach of a single individual. There is reason to believe that the true skate produces its young later in the season than either the thornback or the homelyn.

The breadth of the body is to its length nearly as four to three; the form of the nose conical: the lines from the extreme lateral angle of each pectoral fin being nearly straight, similar lines taken in a direction backward to a point on the tail two inches below the end of the ventral fins, would form a true rhomb: the eyes are slightly elevated above the line of the upper surface of the body, with a short, hard tubercle in the front of each, and a second on the inner side of each; the irides yellow; the temporal orifices valvular, and placed close behind: the dorsal ridge of the body without spines till near the origin of the ventral fins; then commence a single row on the centre, reaching along the tail as far as the first of the two small fins, all the points of the spines directed backwards; one spine between the two small dorsal fins. On the sides of the tail of a female of small size there were no lateral spines; but in a young male of the same size, there were several lateral spines on each side, the points of which were directed forwards, and are in that respect characteristic of this species. The colour of the upper surface of the body and tail grayish brown; the margins anterior to the angles of the pectoral fins tinged with reddish brown; those behind the angles brownish black, darker than the body: the colour on the under surface is sooty white, with dark lines in various directions, and numerous blue specks with small sharp points disposed among them over the surface. The nostrils are valvular, half the width of the mouth in advance of each of its angles; the mouth rather wide; the teeth in this species are sharp in both sexes when adult, the inner angles of the central teeth beginning to elongate in specimens when they are about twelve inches in breadth across the body.

The *Sharp-Nosed Ray*.—This species, says Mr Couch, "may be easily recognised by its sharp snout, by the waved line of the margin of the body from the snout to the extremity of the expansion, and by its pure white colour on the lower surface. It is the largest of the British rays; for though in length and breadth it may not exceed the common skate, its superior thickness renders it heavier."

Colonel Montagu, in the Wernerian Memoirs, says, by way of further distinction, the snout in this species is slender, the lateral margins in a moderately-sized fish running nearly parallel to each other for three or four inches at the extremity. The skin is smooth, with the exception of the spines on the upper surface, peculiar to the males, the colour a plain brown without spots or lines, and never so dark as the skate last described, with which it is sometimes confounded. The teeth of the males, according to a specimen of the mouth very kindly sent to me by Mr Couch, are longer, more pointed, and sharper than those of any other species I have had an opportunity of examining. The tail is armed with three rows of spines. Mr Couch states that the smaller-sized specimens are taken throughout the year; but those which are larger keep in deep waters, and are only taken in summer and autumn. The French are great consumers of skate, and this species is their favourite fish: their boats come to Plymouth during Lent to purchase skate, which they preserve fresh and moist during the run back to their own coast by keeping them covered with wet sand.

This species is the white skate of the Orkneys, and of Scotland generally; and is said to have been taken on the south-east coast of Ireland.

The *Thornback*.—The thornback exhibits very marked distinguishing characters, and being also a very common fish, is one of the best known of the species of rays,



—a term which Mr Couch considers to be derived from the Anglo-Saxon 'Reho,' which means 'rough,' and is particularly appropriate to the thornback, which, on the Cornish coasts, is pre-eminently distinguished as the ray. The thornback is also taken commonly both on the coast of Scotland and Ireland. From the good quality of the flesh of this fish, and the immense quantity taken every year, the thornback, and its female, the maid, is one of the most valuable of the species. Mr Couch says that the flesh takes salt well, and in this preserved state affords the poor fishermen and their families many wholesome meals when stormy weather prevents them obtaining fresh supplies. The thornback is taken in the greatest abundance during spring and summer, because the fish then frequent sandy bottoms in shallower water and nearer the shore than usual, for the purpose of depositing their eggs; but the flesh of the thornback at this season is not, as before noticed, so firm as in autumn and winter. It is in the best condition for table about November. Their food is various other fish, particularly flatfish, testaceous mollusca, and crustacea.—*Yarrell's British Fishes, Vol. II.*

posed venom on its surface; and the animal has no gland that separates the noxious fluid; besides, all those animals that are furnished with envenomed fangs or stings, seem to have them strongly connected with their safety and existence; they never part with them; there is an apparatus of poison prepared in the body to accompany their exertions; and when the fangs or stings are taken away, the animal languishes and dies. But it is otherwise with the spine of the fire flare; it is fixed to the tail, as a quill is into the tail of a fowl, and is annually shed in the same manner: it may be necessary for the creature's defence, but it is no way necessary for its existence. The wound inflicted by an animal's tail, has something terrible in the idea, and may from thence alone be supposed to be fatal. From hence terror might have added poison to the pain, and called up imagined dangers; the Negroes universally believe that the sting is poisonous; but they never die of the wound; for by opening the fish, and laying it on the part injured, it effects a speedy cure. The slightness of the remedy proves the innocence of the wound.[1]

The Torpedo (see Plate XXI. fig. 10.) is an animal of this kind, equally formidable and well known with the former; but the manner of its operating is to this hour a mystery to mankind.[2] The body of this fish is almost circular, and thicker than others of the ray kind; the skin is soft, smooth, and of a yellowish colour, marked, as all the kind, with large annular spots; the eyes very small; the tail tapering to a point; and the weight of the fish from a quarter to fifteen pounds. Redi found one twenty-four pounds weight. To all outward appearance, it is furnished with no extraordinary powers; it has no muscles formed for particularly great exertions; no internal conformation perceptibly differing from the rest of its kind; yet such is that unaccountable power it possesses, that, the instant it is touched, it numbs not only the hand and arm, but sometimes also the whole body. The shock received, by all accounts, most resembles the stroke of an electrical machine; sudden, tingling, and painful. "The instant," says Kempfer, "I touched it with my hand, I felt a terrible numbness in my arm, and as far up as the shoulder. Even if one treads upon it with the shoe on, it affects not only the leg, but the whole thigh upwards. Those who touch it with the foot, are seized with a stronger palpitation than even those who touch it with the hand.—This numbness bears no resemblance to that which we feel when a nerve is a long time pressed, and the foot is said to be asleep; it rather appears like a sudden vapour, which passing through the pores in an instant, penetrates to the very springs of life, from whence it diffuses itself over the whole body, and gives real pain. The nerves are so affected, that the person struck imagines all the bones of his body, and particularly those of the limb that received the blow, are driven out of joint. All this is accompanied with a universal tremor, a sickness of the stomach, a general convulsion, and a total suspension of the faculties of the mind. In short," continues Kempfer, "such is the pain, that all the force of our promises and authority could not prevail upon a seaman to undergo the shock a second time. A negro, indeed, that was standing by, readily undertook to touch the torpedo, and was seen to handle it without feeling any of its effects. He informed us, that his whole secret consisted in keeping in his breath; and we found, upon trial, that this method answered with ourselves. When we held in our breath, the torpedo was harmless; but when we breathed ever so little, its efficacy took place."

Kempfer has very well described the effects of this animal's shock; but succeeding experience has abundantly convinced us, that holding in the breath no way guards against its violence. Those, therefore, who depending on that receipt, should play with a torpedo, would soon find themselves painfully undeceived: not but that this fish may be many times touched with perfect security; for it is not upon every occasion that it exerts its potency. Reaumur, who made several trials upon this animal, has at least convinced the world that it is not necessarily, but by an effort, that the torpedo numbs the hand of him that touches it. He tried several times, and could easily tell when the fish intended the stroke, and when it was about to continue harmless. Always before the fish intended the stroke, it flattened the back, raised the head and the tail, and then, by a violent contraction in the opposite direction, struck with its back against the pressing finger; and the body, which before was flat became humped and round.

But we must not infer, as he has done, that the whole effect of this animal's exertion arises from the greatness of the blow which the fingers receive at the instant they are struck. We will, with him, allow the stroke is very powerful, equal to that of a musquet-ball, since he will have it so; but it is very well known, that a blow, though never so great, on the

[1] The account of the venomous properties of this spine, as well as that it is shed annually, appears to be altogether fabulous. It is probable that, by its great strength, it may be able to inflict a painfully lacerated wound.

[2] The *Torpedo Ray* is rare on the British coast. Two or three species inhabit the Mediterranean, and others are to be found in different parts of the world.

points of the fingers, diffuses no numbness over the whole body : such a blow might break the ends of the fingers indeed, but would hardly numb the shoulder. Those blows that numb, must be applied immediately to some great and leading nerve, or to a large surface of the body ; a powerful stroke applied to the points of the fingers will be excessively painful indeed, but the numbness will not reach beyond the fingers themselves. We must, therefore, look for another cause producing the powerful effects wrought by the torpedo.

Others have ascribed it to a tremulous motion which this animal is found to possess, somewhat resembling that of a horse's skin, when stung by a fly. This operating under the touch with an amazing quickness of vibration, they suppose produces the uneasy sensation described above ; something similar to what we feel when we rub plush cloth against the grain. But the cause is quite disproportioned to the effect ; and so much beyond our experience, that this solution is as difficult as the wonder we want to explain.

The most probable solution seems to be, that the shock proceeds from an animal electricity, which this fish has some hidden power of storing up, and producing on its most urgent occasions. The shocks are entirely similar ; the duration of the pain is the same ; but how the animal contrives to renew the charge, how it is prevented from evaporating on contiguous objects, how it is originally procured, these are difficulties that time alone can elucidate.

But to know even the effects is wisdom. Certain it is, that the powers of this animal seem to decline with its vigour ; for as its strength ceases, the force of the shock seems to diminish ; till, at last, when the fish is dead, the whole power is destroyed, and it may be handled or eaten with perfect security : on the contrary, when immediately taken out of the sea, its force is very great, and not only affects the hand, but if even touched with a stick, the person finds himself sometimes affected. This power, however, is not to be extended to the degree that some would have us believe ; as reaching the fisherman at the end of the line, or numbing fishes in the same pond. Godignus, in his History of Abyssinia, carries this quality to a most ridiculous excess ; he tells us of one of these that was put into a basket among a number of dead fishes, and that the next morning the people, to their utter astonishment, perceived that the torpedo had actually numbed the dead fishes into life again ![1]

To conclude, it is generally supposed that the female torpedo is much more powerful than the male. Lorenzini, who has made several experiments upon this animal, seems

[1] The *Gymnotus*, or *Electric Eel*—The gymnoti, or electrical eels, which resemble large water serpents, inhabit several streams of South America, and abound also in the Oroonoko, the Amazon, and the Meta, but the strength of the current, and the depth of the water in these large rivers, prevent their being caught by the Indians. They see these fish less frequently than they feel electric shocks from them, when swimming or bathing in the river. To catch the gymnoti with nets is very difficult, on account of the extreme agility of the fish, which bury themselves in the mud like serpents. Roots are sometimes thrown into the water to intoxicate or benumb these animals, but we would not employ these means, as they would have enfeebled the gymnoti : the Indians, therefore, told us, that they would "fish with horses." We found it difficult to form an idea of this extraordinary manner of fishing; but we soon saw our guides return from the savannah, which they had been scouring for wild horses and mules. They brought about thirty with them, which they forced to enter the pool.

The extraordinary noise caused by the horses' hoofs, makes the fish issue from the mud, and excites them to combat; they swim on the surface of the water, and crowd under the bellies of the horses and mules. A contest between animals of so different an organization, furnishes a very striking spectacle. The Indians, provided with harpoons and long slender reeds, surround the pool closely ; and some climb upon the trees, the branches of which extend horizontally over the surface of the water. By their wild cries, and the length of their reeds, they prevent the horses from running away, and reaching the bank of the pool. The eels, stunned by the noise, defend themselves by the repeated discharge of their electric power, and during a long time they seem to prove victorious. Several horses sink beneath the violence of the invisible strokes, which they receive from all sides, and stunned by the force and frequency of the shocks, disappear under the water. Others panting, with mane erect, and haggard eyes, expressing anguish, raise themselves, and endeavour to flee from the storm by which they are overtaken. They are driven back by the Indians into the middle of the water; but a small number succeed in eluding the active vigilance of the fishermen. These regain the shore, stumbling at every step, and stretch themselves on the sand, exhausted with fatigue, and their limbs benumbed by the electric shocks of the gymnoti. In less than five minutes two horses were drowned. The eel being five feet long, and pressing itself against the belly of the horses, makes a discharge along the whole extent of its electric organ. The horses are probably only stunned, not killed, but they are drowned from the impossibility of rising, amid the prolonged struggles between the other horses and the eels.

We had little doubt, that the fishing would terminate by killing, successively, all the animals engaged, but, by degrees, the impetuosity of this unequal contest diminished, and the wearied gymnoti dispersed. The mules and horses appeared less frightened; their manes no longer bristled, and their eyes expressed less dread. The gymnoti, which require a long rest and abundant nourishment to repair what they have lost of galvanic force, approach timidly the edge of the marsh, where they are taken by means of small harpoons, fastened to long cords.

The gymnotus is the largest of electrical fishes ; I measured some that were from five to five feet three inches long, and the Indians assert that they have seen still longer. We found that a fish of three feet ten inches long weighed twelve pounds; the transverse diameter of the body was three inches five lines. The gymnoti

convinced that its power wholly resides in two thin muscles that cover a part of the back. These he calls the trembling fibres; and he asserts that the animal may be touched with safety in any other part. It is now known also that there are more fish, than this of the ray kind, possessed of the numbing quality, which has acquired them the name of the torpedo. These are described by Atkins and Moore, and found in great abundance along the coast of Africa. They are shaped like a mackarel, except that the head is much larger; the effects of these seem also to differ in some respects. Moore talks of keeping his hand upon the animal; which in the ray torpedo it is actually impossible to do. "There was no man in the company," says he, "that could bear to keep his hand on this animal the twentieth part of a minute, it gave him so great pain; but upon taking the hand away, the numbness went off, and all was well again. This numbing quality continued in this torpedo even after it was dead; and the very skin was still possessed of its extraordinary power till it became dry." Condamine informs us of a fish possessed of the powers of the torpedo, of a shape very different from the former, and every way resembling a lamprey. This animal, if touched by the hand, or even with a stick, instantly benumbs the hand and arm to the very shoulder; and sometimes the man falls down under the blow. These animals, therefore, must affect the nervous system in a different manner from the former, both with respect to the manner and the intention; but how this effect is wrought, we must be content to dismiss in obscurity.

of Cano de Bera are of a fine olive-green; the under part of the head is yellow, mingled with red. Along the back are two rows of small yellow spots, from which exudes a slimy matter that spreads over the skin of the animal, and which, as Volta has proved, conducts electricity twenty or thirty times better than pure water. It is, in general, somewhat remarkable, that no electrical fish yet discovered in the different parts of the world, is covered with scales.

The gymnoti, which are objects of the most lively interest to the philosopher of Europe, are dreaded and detested by the natives. Their flesh furnishes pretty good food, but the electric organ fills the greater part of the body, and this being slimy and disagreeable to the taste, is carefully separated from the rest. The presence of the gymnoti is also considered as the principal cause of the want of fish in the ponds and pools of the Llanos, where they kill many more fish than they devour. The Indians told us, that when they take young alligators and gymnoti at the same time in very strong nets, the latter never display the slightest trace of a wound, because they disable the young alligators before they are attacked by them. All the inhabitants of the waters dread the gymnoti; lizards, tortoises, and frogs, seek the pools, where they are secure from their action. It became necessary to change the direction of a road near Uritucu, because these electrical eels were so numerous in one river, that they every year killed a great number of mules of burden as they forded the river.

It would be temerity to expose ourselves to the first shocks of a very large and strongly irritated gymnotus. If by chance you receive a stroke before the fish is wounded, or wearied by a long pursuit, the pain and numbness are so violent, that it is impossible to describe the nature of the feeling they excite. I do not remember having ever received from the discharge of an electrical machine, a more dreadful shock, than that which I experienced by imprudently placing both my feet on a gymnotus just taken out of the water. I was affected the rest of the day with a violent pain in the knees, and in almost every joint.—*Humboldt's Personal Narrative.*

CHAP. IV.

OF THE LAMPREY, AND ITS AFFINITIES.[1]

THERE is a species of the Lamprey served up as a great delicacy among the modern

The governor at New Amsterdam has a large electric eel, which he has kept for several years in a tub, made for that purpose, placed under a small shed near to the house. This fish possesses strong electrical powers, and often causes scenes of diversion among the soldiers and sailors, who are struck with astonishment at its qualities, and believe it to be in league with some evil spirit. Two sailors, wholly unacquainted with the properties of the animal, were one day told to fetch an eel, which was lying in the tub in the yard, and give it the cook to dress for dinner. It is a strong fish, of seven or eight pounds weight, and gives a severe shock on being touched, particularly if at all irritated or enraged. The sailors had no sooner reached the shed, than one of them plunged his hand to the bottom of the tub to seize the eel; when he received a blow which benumbed his whole arm: without knowing what it was, he started from the tub, shaking his fingers, and holding his elbow with his other hand, crying out, "I say, Jack, what a thump he fetched me with his tail!" His messmate, laughing at "such a foolish notion," next put down his hand to reach out the eel, but receiving a similar shock, he snapped his fingers likewise, and ran off, crying out, "Why, he did give you a thump! He's a fighting fellow: he has fetched me a broadside too! Let's both have a haul at him together, Jack; then we shall board his slippery carcass, spite of his rudder." Accordingly they each plunged their hands into the tub, and seized the fish, by a full grasp round the body. This was rougher treatment than he commonly experienced, and he returned it with a most violent shock, which soon caused them to quit their hold. For a moment they stood aghast, then rubbing their arms, holding their elbows, and shaking their fingers, they capered about with pain and amazement, swearing that their arms were broken, and that it was the devil in the tub in the shape of an eel. They now perceived that it was not a simple blow with the tail which they had felt before; nor could they be prevailed upon to try again to take out the fish, but stole away, rubbing their elbows, and abusing "the trick about the cook and the eel."—*Pinckard's Notes on the West Indies.*

[1] *Lampreys.*—These fishes are, in reference to their skeleton, and in some other respects, the lowest in the scale of organization among vertebrated animals.

The lampreys, like the sharks and rays, have no swimming-bladder; and being also without pectoral fins, are usually seen near the bottom. To save themselves from the constant muscular exertion which is necessary to prevent them being carried along by the current of the water, they attach themselves by the mouth to stones or

Romans, very different from ours. Whether theirs be the maræna of the ancients, I will not pretend to say; but there is nothing more certain than that our lamprey is not. The Roman lamprey agrees with the ancient fish in being kept in ponds, and considered by the luxurious as a very great delicacy.

The lamprey, known among us, is differently estimated, according to the season in which it is caught, or the place where it has been fed. Those that leave the sea to deposit their spawn in fresh waters are the best: those that are entirely bred in our rivers, and that have never been at sea, are considered as much inferior to the former. Those that are taken in the months of March, April, or May, just upon their leaving the sea, are reckoned very good; those that are caught after they have cast their spawn, are found to be flabby, and of little value. Those caught in several of the rivers in Ireland, the people will not venture to touch; those of the English Severn, are considered as the most delicate of all other fish whatever.

The lamprey much resembles an eel in its general appearance, but is of a lighter colour, and rather a clumsier make. It differs however in the mouth, which is round, and placed rather obliquely below the end of the nose. It more resembles the mouth of a leech than an eel; and the animal has a hole on the top of the head through which it spouts water, as in the cetaceous kind. There are seven holes on each side for respiration; and the fins are formed rather by a lengthening out of the skin, than any set of bones or spines for that purpose. As the mouth is formed resembling that of a leech, so it has a property resembling that animal, of sticking close to and sucking any body it is applied to. It is extraordinary the power they have of adhering to stones; which they do so firmly, as not to be drawn off without some difficulty. We are told of one that weighed but three pounds, and yet it stuck so firmly to a stone of twelve pounds, that it remained suspended at its mouth, from which it was separated with no small difficulty. This amazing power of suction is supposed to

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rocks, and were in consequence called *Petromyzon*, or Stone-sucker; while the circular form of the mouth induced the name of *Cyclostomes*, or Round-mouthed Fishes, which was bestowed upon them by M. Dumeril.

In reference to the respiratory apparatus in the species of this genus, Mr Owen has remarked, that "when the lamprey is firmly attached, as is commonly the case, to foreign bodies by means of its suctorial mouth, it is obvious that no water can pass by that aperture from the pharynx to the gills; it is therefore alternately received and expelled by the external apertures. If a lamprey, while so attached to the side of a vessel, be held with one series of apertures out of the water, the respiratory currents are seen to enter by the submerged orifices, and, after traversing the corresponding sacs and the pharynx, to pass through the opposite branchiæ, and to be forcibly ejected therefrom by the exposed orifices. The same mode of respiration must take place in the Mixine," (a species of this family to be described immediately) "while its head is buried in the flesh of its prey. The cyclostomous fishes thus present an obvious affinity to the *Cephalopoda*, inasmuch as the branchial currents are independent of the actions of the parts concerned in deglutition."

The intestinal canal is small, and extends in a straight line along the abdomen to the anal aperture without any convolution. The lampreys are oviparous, spawning late in the spring; the roe escaping, in both sexes, by a small membranous sheath, which has internally at its base five apertures, one leading upward to the intestine, one to each kidney, and one to each lateral cavity of the abdomen.

The Marine Lamprey, (see Plate XXII. fig. 5.) which from its mottled appearance was called *P. maculosus*, by Artedi, has a very extensive geographical range. It is found in the Mediterranean, and from thence northwards in most of the rivers of Europe as far as Scandinavia, during the spring. Professor Reinhardt includes it among the fishes of Iceland, and our countryman Pennant gives it a place in his Arctic Zoology. From a description and figure in the Natural History of the Fishes of Massachusetts, by Dr Smith of Boston, this fish appears to be common in the rivers of North America, attaining a large size in those of the more southern states, but not exceeding seventeen or twenty inches in length in a high northern latitude. Dr Mitchell also includes this species among his fishes of New York. It is rather common during spring and summer in some of the rivers on the southern coast of England, particularly the Severn, and is found in smaller numbers in several of the rivers of Scotland and Ireland about the same period of the year.

In Scotland, the appearance of the lamprey in the fresh water is rather later in the year than in the rivers of the south. Sir William Jardine says, "They ascend our rivers to breed about the end of June, and remain until the beginning of August. They are not furnished with any elongation of the jaw, afforded to most of our fresh-water fish, to form the receiving furrows at this important season; but the want is supplied by their sucker-like mouth, by which they individually remove each stone. Their power is immense. Stones of a very large size are transported, and a large furrow is soon formed. The *P. marinus* remain in pairs, two on each spawning place; and while there employed, retain themselves affixed by the mouth to a large stone."

After the spawning season is over, the flesh of the lamprey, like that of other fish, loses for a time its firmness and other good qualities, and the weakened fish makes its way back to the sea, to recruit its wasted condition. The food of the lamprey consists generally of any soft animal matter; and in the sea it is known to attack other fishes even of large size, by fastening upon them, and with its numerous small rasp-like teeth eating away the soft parts down to the bone. It is not very often caught while it remains at sea.

This species usually measures from twenty to twenty-eight inches in length.

The *River Lamprey*, or *Lampern*, as it is called by fishermen for distinction, is a well-known species which abounds in many rivers of England, particularly the Thames, the Severn, and the Dee: it is also abundant in several rivers of Scotland and Ireland. Some authors state that this species, like that last described, visits our rivers in spring, and returns to the sea after spawning; but the recorded opinions of others, and my own observations, induce me to believe that it generally remains all the year in the fresh water. In the Thames I am certain it is to be obtained every month in the year; but is considered in the best condition for the table from

arise from the animal's exhausting the air within its body by the hole over the nose, while the mouth is closely fixed to the object, and permits no air to enter. It would be easy to determine the weight this animal is thus able to sustain; which will be equal to the weight of a column of air of equal diameter with the fish's mouth.

From some peculiarity of formation, this animal swims generally with its body as near as possible to the surface; and it might easily be drowned by being kept by force for any time under water. Muralto has given us the anatomy of this animal; but, in a very minute description, makes no mention of lungs. Yet I am very apt to suspect, that two red glands tissued with nerves, which he describes as lying towards the back of the head, are no other than the lungs of this animal. The absolute necessity it is under of breathing in the air, convinces me that it must have lungs, though I do not know of any anatomist that has described them.

The adhesive quality in the lamprey may be, in some measure, increased by that slimy substance with which its body is all over smeared; a substance that serves at once to keep it warm in its cold element, and also to keep its skin soft and pliant. This mucus is separated by two long lymphatic canals, that extend on each side from the head to the tail, and that furnish it in great abundance. As to its intestines, it seems to have but one great bowel, running from the mouth to the vent, narrow at both ends, and wide in the middle.

So simple a conformation seems to imply an equal simplicity of appetite. In fact, the lamprey's food is either slime and water, or such small water-insects as are scarcely perceivable. Perhaps its appetite may be more

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October to March, during which time it is permitted to be caught, according to the rules adopted for the conservation of the fishery.

Formerly the lampern was considered a fish of considerable importance. It was taken in great quantities in the Thames from Battersea Reach to Taplow Mills, and was sold to the Dutch as bait for the turbot, cod, and other fisheries. Four hundred thousand have been sold in one season for this purpose, at the rate of forty shillings per thousand. From five pounds to eight pounds the thousand have been given; but a comparative scarcity of late years, and consequent increase in price, has obliged the line fishermen to adopt other substances for bait. Formerly the Thames alone supplied from one million to twelve hundred thousand lamperns annually. They are very tenacious of life, and the Dutch fishermen managed to keep them alive at sea for many weeks.

If this species, which is very easily obtained, be examined in the months of March or April, the distinction of the sexes will be immediately evident on opening them. The female may generally be known externally by the larger size of the abdomen, and the male by his lips being more tumid and the mouth larger than that of the female.—The season of spawning is May, and the process has been described by several observers. This sometimes takes place in pairs only, and at others by many of both sexes occupying one general spawning bed.

The food of this species, according to Bloch, is insects, worms, small fish, and the flesh of dead fish. The adult fish is usually from twelve to fifteen inches in length.—*Yarrell's British Fishes, Vol. II.*

The *Myxine Glutinous Hag-fish, or Borer*, a species of lamprey, (see Plate XXII. fig. 2.)—This little fish, although seldom more than twelve or fourteen inches in length, is well deserving of notice, on account of its singular method of obtaining its food. The myxine is found as far north as the shores of Scandinavia, and it is also of frequent occurrence on the British coasts, more particularly off Scarborough. It enters, says Pennant, the mouths of other fish when on the hooks attached to the lines, which remain a tide under water, and totally devours the whole except the skin and bones. The Scarborough fishermen often take it in the *robbed fish* on drawing up their lines. On this account it is called, on this part of the coast, the Hag or the Borer, because, as others say, it first pierces a small aperture in the skin, and afterwards buries its head in the body of its prey. It is most usually found in the body of the cod, or some other equally rapacious fish.

Its worm-like figure induced several systematic writers to class it with the worms, and "it was not till after dissections and published descriptions, that its true relations with the lampreys were acknowledged."

"The myxine, (says Mr Yarrell,) is not uncommon at Berwick, but it is only to be obtained at a particular season of the year, in one or two localities, when, during fine weather, at the end of spring, or the beginning of summer, the fishermen lay their long lines, on a bank with a soft mud bottom, near the coast, when fishing for cod or haddock. It is considered by some, that the myxine, which is without eyes, obtains access to the interior of the body of the fish by passing in at the anal aperture; others endeavour to account for its being found in the belly of a voracious fish, by supposing it had been swallowed; while many experienced fishermen still repeat their belief, that the myxine enters the mouth of the cod-fish while it is hanging on the line. It is conjectured that the myxine does not fasten upon any fish, unless it be either dead or hanging on a hook; but how a fish that is blind is able to find its way to a particular aperture, is a matter not easily explained. The eight barbules, or cirri, about the mouth of the myxine are, there is no doubt, delicate organs of touch, by which it obtains cognizance of the nature and quality of the substances with which they are in contact, and its single-hooked tooth upon the palate enables it to retain its hold till the double rows of teeth, or the tongue, are brought into action, to aid the desire to obtain food."

Along the whole length of the under surface of the body, from head to tail, there are two rows of mucous pores, from which a large quantity of a gelatinous secretion is expressed occasionally, at the will of the animal, and by which, in reference either to its quality or quantity, or both, this fish is said to escape its enemies. So copious and so thick in its consistence is this jelly-like secretion, that some of the older naturalists believed this fish had the power of converting water into glue, and it obtained in consequence the name of the Glutinous Hag.

The body is long, and cylindrical throughout nearly its whole length, tapering and compressed near the tail; in colour the myxine is dark-brown along the back, lighter chesnut-brown along the sides, and yellowish-white underneath.

The bones of the back in the lamprey are of a soft consistence, and indistinctly divided into rounded portions. In the myxine, in place of a series of bones composing the vertebral column, there is merely a soft and flexible cartilaginous tube.

active at sea, of which it is properly a native; but when it comes up into our rivers, it is hardly perceived to devour any thing.

Its usual time of leaving the sea, which it is annually seen to do in order to spawn, is about the beginning of spring; and after a stay of a few months it returns again to the sea. Their preparation for spawning is peculiar; their manner is to make holes in the gravelly bottom of rivers; and on this occasion their sucking power is particularly serviceable; for if they meet with a stone of a considerable size they will remove it, and throw it out. Their young are produced from eggs in the manner of flat fish; the female remains near the place where they are excluded, and continues with them till they come forth. She is sometimes seen with her whole family playing about her; and after some time she conducts them in triumph back to the ocean.

But some have not sufficient strength to return; and these continue in the fresh water till they die. Indeed the life of this fish, according to Rondeletius, who has given its history, is but of very short continuance; and a single brood is the extent of the female's fertility. As soon as she has returned after casting her eggs, she seems exhausted and flabby. She becomes old before her time; and two years is generally the limit of her existence.

However this may be, they are very indifferent eating after they have cast their eggs, and particularly at the approach of hot weather. The best season for them is the months of March, April, and May; and they are usually taken in nets with salmon, and sometimes in baskets at the bottom of the river. It has been an old custom for the city of Gloucester annually to present the king with a lamprey-pie; and as the gift is made at Christmas, it is not without great difficulty the corporation can procure the proper quantity, though they give a guinea a-piece for taking them.[1]

How much they were valued among the ancients, or a fish bearing some resemblance to them, appears from all the classics that have praised good living, or ridiculed gluttony. One story we are told of this fish, with which I will conclude its history. A senator of Rome, whose name does not deserve being transmitted to posterity, was famous for the delicacy of his lampreys. Tigelinus Manucius, and all the celebrated epicures of Rome, were loud in his praises: no man's fish had such a flavour, was so nicely fed, or so exactly pickled. Augustus, hearing so much of this man's entertainments, desired to be his guest; and soon found that fame had been just to his merits; the man had indeed very fine lampreys, and of an exquisite flavour. The emperor was desirous of knowing the method by which he fed his fish to so fine a relish; and the glutton, making no secret of his art, informed him, that his way was to throw into his ponds such of his slaves as had at any time displeased him. Augustus, we are told, was not much pleased with his receipt, and instantly ordered all his ponds to be filled up. The story would have ended better if he had ordered the owner to be flung in also.

[1] Henry I. of England died of a surfeit from eating lampreys.

CHAP. V.

OF THE STURGEON, AND ITS VARIETIES.

The Sturgeon, with a form as terrible, and a body as large, as the shark, is yet as harmless as the fish we have been just describing; incapable and unwilling to injure others, it flies from the smallest fishes, and generally falls a victim to its own timidity.

The sturgeon, in its general form, resembles a fresh water pike. The nose is long; the



mouth is situated beneath, being small, and without jaw-bones or teeth. But though it is so harmless and ill provided for war, the body is formidable enough to appearance. It is long, pentagonal, and covered with five rows of large bony knobs, one row on the back and two on each side, and a number of fins to give it greater expedition. Of this fish there are three kinds; the Common Sturgeon, the Caviar Sturgeon, and the Huso or Isinglass Fish. The first has eleven knobs or scales on the back; the second has fifteen; and the latter thirteen on the back, and forty-three on the tail. These differences seem light to us who only consider the animal's form; but those who consider its uses find the distinction of considerable importance. The first is the sturgeon, the flesh of which is sent pickled into all parts of Europe. The second, is the fish from the roe of which that noted delicacy called caviar is made; and the third, besides supplying the caviar, furnishes also the valuable commodity of isinglass. They all grow to a very great size; and some of them have been found above eighteen feet long.

There is not a country in Europe but what this fish visits at different seasons; it annually ascends the largest rivers to spawn, and propagates in an amazing number. The inhabi-

tants along the banks of the Po, the Danube, and the Wolga make great profit yearly of its incursions up the stream, and have their nets prepared for its reception.[1] The sturgeon also is brought daily to the markets of Rome and Venice, and they are known to abound in the Mediterranean sea. Yet those fish that keep entirely either in salt or fresh water are but comparatively small. When the sturgeon enjoys the vicissitude of fresh and salt water, it is then that it grows to an enormous size, so as almost to rival even the whale in magnitude.

Nor are we without frequent visits from this much esteemed fish in England. It is often accidentally taken in our rivers in salmon-nets, and particularly in those parts that are not far remote from the sea. The largest we have heard of, caught in Great Britain, was a fish taken in the Eske, where they are most frequently found, which weighed four hundred and sixty pounds.[2] An enormous size to those who have only seen our fresh-water fishes!

North America also furnishes the sturgeon: their rivers in May, June, and July, supply them in very great abundance. At that time they are seen sporting in the water, and leaping from its surface several yards into the air. When they fall again on their sides, the concussion is so violent, that the noise is heard, in still weather, at some miles' distance.

But of all places where this animal is to be found, it appears no where in such numbers as in the lakes of Frischehaff and Curischaff, near the city of Pillau. In the rivers also that empty themselves into the Euxine sea this fish is caught in great numbers, particularly at the mouth of the river Don. In all these places the fishermen regularly expect their arrival from the sea, and have their nets and salt ready prepared for their reception.

As the sturgeon is a harmless fish, and no way voracious, it is never caught by a bait in the ordinary manner of fishing, but always in nets. From the description given above of its mouth, it is not to be supposed that the sturgeon would swallow any hook capable of holding so large a bulk and so strong a swimmer. In fact, it never attempts to seize any of the finny tribe, but lives by rooting at the bottom of the sea, where it makes insects and sea-plants its whole subsistence. From this quality of floundering at the bottom it has received its name; which comes from the German verb *floeren*, signifying to wallow in the mud. That it lives upon no large animals is obvious to all those who cut it open, where nothing is found in its stomach but a kind of slimy substance, which has induced some to think it lives only upon water and air. From hence there is a German proverb, which is applied to a man extremely temperate, when they say, he is as moderate as a sturgeon.

As the sturgeon is so temperate in its appetites, so is it also equally timid in its nature. There would be scarcely any method of taking it, did not its natural desire of propagation induce it to incur so great a variety of dangers. The smallest fish is alone sufficient to terrify a shoal of sturgeons; for, being unfurnished with any weapon of defence, they are obliged to trust to their swiftness and their caution for security. Like all animals that do not make war upon others, sturgeons live in society among themselves: rather for the purposes of pleasure than from any power of mutual protection. Gesner even asserts, that they are delighted with sounds of various kinds; and that he has seen them shoal together at the notes of a trumpet.

The usual time, as was said before, for the sturgeon to come up rivers to deposit its spawn, is about the beginning of summer, when the fishermen of all great rivers make a regular preparation for its reception. At Pillau, particularly, the shores are formed into districts, and allotted to companies of fishermen, some of which are rented for about three hundred pounds a-year. The nets in which the sturgeon is caught are made of small cord, and placed across the mouth of the river; but in such a manner that, whether the tide ebbs or flows, the pouch of the net goes with the stream.—The sturgeon thus caught, while in the water, is one of the strongest fishes that swims, and often breaks the net to pieces that incloses it; but the instant it is raised, with

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[1] *Sturgeon Fishery.*—The river Volga, especially near its mouth, is the principal scene of this fishery. When the fish enter the river, which they do, like many others, at stated seasons, for the purpose of depositing their spawn, large enclosures of strong stakes are set across the river to intercept and prevent its return; the enclosures narrow up the river, and the animal, getting into these confined places, is easily speared.

This fish (*Accipenser sturo*, or common sturgeon; for *Accipenser huso*, see Plate XXI. fig. 27.) of which there are several species, breeds in the Caspian sea, in such numbers as to fill the rivers flowing into that lake. Fifteen thousand sturgeons are sometimes taken in one day, with the hook, at the station of Sallian, on the Persian coast, and upwards of 700,000 were taken in the year 1829, in the Russian dominions on the coasts of the Caspian.

The flesh of the sturgeon is salted and dried for consumption during the numerous fasts enjoined by the Greek church, but the two products the most valuable, are isinglass and *caviare*. The former is prepared from the air-bladder, and large quantities of it are annually imported into England from St Petersburg. *Caviare* is a preparation from the roe, of a strong, oily, but agreeable flavour, and is increasing in estimation here, if we may judge by the increased importation of it; a great deal is also consumed in Italy.

[2] One caught in a stake net near Findhorn, in Scotland, in July, 1833, measured eight feet six inches in length, and weighed two hundred and three pounds.

its head above water, all its activity ceases; it is then a lifeless, spiritless lump, and suffers itself to be tamely dragged on shore. It has been found prudent, however, to draw it to shore gently; for if excited by any unnecessary violence, it has been found to break the fisherman's legs with a blow of its tail. The most experienced fishers, therefore, when they have drawn it to the brink, keep the head still elevated, which prevents its doing any mischief with the hinder part of the body; others, by a noose, fasten the head and the tail together; and thus without immediately despatching it, bring it to the market, if there be one near, or keep it till their number is completed for exportation.

The flesh of this animal, pickled, is very well known at all the tables of Europe; and is even more prized in England than in any of the countries where it is usually caught. The fishermen have two different methods of preparing it. The one is by cutting it in long pieces lengthwise, and, having salted them, by hanging them up in the sun to dry: the fish thus prepared is sold in all the countries of the Levant, and supplies the want of better provisions. The other method, which is usually practised in Holland, and along the shores of the Baltic, is to cut the sturgeon crosswise, into short pieces, and put it in small barrels, with a pickle made of salt and saumure. This is the sturgeon which is sold in England; and of which great quantities came from the North, until we gave encouragement to the importation of it from North America. From thence we are very well supplied; but it is said, not with such good fish as those imported from the North of Europe.

A very great trade is also carried on with the roe of the sturgeon, preserved in a particular manner, and called Caviare: it is made from the roe of all kinds of sturgeon, but particularly the second. This is much more in request in other countries of Europe than with us. To all these high-relished meats, the appetite must be formed by degrees; and though formerly, even in England, it was very much in request at the politest tables, it is at present sunk entirely into disuse. It is still, however, a considerable merchandise among the Turks, Greeks, and Venetians. Caviare somewhat resembles soft soap in consistence; but it is of a brown, uniform colour, and is eaten as cheese with bread. The manner of making it is this: they take the spawn from the body of the sturgeon—for it is to be observed, the sturgeon differs from other cartilaginous fish, in that it has spawn like a cod, and not eggs like a ray. They take the spawn, I say, and freeing it from the small membranes that connect it together, they wash it with vinegar, and afterwards spread it to dry upon a table; they then put them into a vessel with salt, breaking the spawn with their hands, and not with a pestle; this done, they put it into a canvass bag, letting the liquor drain from it; lastly, they put it into a tub, with holes in the bottom, so that, if there be any moisture still remaining, it may run out; then it is pressed down, and covered up close for use.

But the Huso or Isinglass fish furnishes a still more valuable commodity. This fish is caught in great quantities in the Danube, from the month of October to January: it is seldom under fifty pounds weight, and often above four hundred: its flesh is soft, glutinous, and flabby; but it is sometimes salted, which makes it better tasted, and then it turns red like salmon. It is for the commodity it furnishes that it is chiefly taken. Isinglass is of a whitish substance, inclining to a yellow, done up into rolls, and so exported for use. It is very well known as serviceable, not only in medicine, but many arts. The varnisher, the wine-merchant, and even the clothier, know its uses; and very great sums are yearly expended upon this single article of commerce. The manner of making it is this: they take the skin, the entrails, the fins, and the tail of this fish, and cut them into small pieces; these are left to macerate in a sufficient quantity of warm water, and they are all boiled shortly after with a slow fire, until they are dissolved and reduced to a jelly; this jelly is spread upon instruments made for the purpose, so, that drying, it assumes the form of parchment, and, when quite dry, it is then rolled into the form which we see in the shops.[1]

This valuable commodity is principally furnished from Russia, where they prepare great quantities surprisingly cheap. Mr Jackson, an ingenious countryman of our own, found out an obvious method of making a glue at home that answered all the purposes of isinglass; but what with the trouble of making it, and perhaps the arts put in practice to undersell him, he was, as I am told, obliged to discontinue the improvement of his discovery. Indeed, it is a vain attempt to manufacture among ourselves those things which may be more naturally and cheaply supplied elsewhere. We have many trades that are unnaturally, if I may so express it, employed among us; who furnish more laboriously those necessaries with which other countries could easily and cheaply supply us. It would be wiser to take what they can thus produce; and to turn our artizans to the increase and manu-

[1] Isinglass is prepared from various other fishes, but principally from the White Dolphin, or Belluga of North America. This well-known substance is made from the sound, or air-bladder.

facture of such productions as thrive more readily among us. Were, for instance, the number of hands that we have now employed in the manufacture of silk, turned to the increase of agriculture, it is probable that the increased quantity of corn thus produced, would be more than an equivalent for the diminution of national wealth in purchasing wrought silk from other countries

CHAP. VI.

OF ANOMALOUS CARTILAGINOUS FISHES.[1]

Of all others, the Cartilaginous class seems to abound with the greatest variety of ill-formed animals; and, if philosophy could allow the expression, we might say, that the cartilaginous class was the class of monsters; in fact, it exhibits a variety of shapeless beings,

[1] *Eels*.—The general appearance of the Eel is so well known, and so unlike that of most other fishes, as to require but a slight description; yet it was not till a period of very modern date that naturalists became acquainted with the fact that the fresh waters of several countries produce three or four distinct species which had previously been confounded together. Thus the first edition of the *Règne Animal*, published in 1817, included but one species of common fresh-water eel as well known: the second edition, published in 1829, contains a short notice of four different species; three of which, if not all four, are found in this country.

The form of the eel, resembling that of the serpent, has long excited a prejudice against it, which exists in some countries even to the present time; and its similarity to snakes has even been repeated by those, who, from the advantages of education, and their acquirements in natural history, might have been supposed capable of drawing more accurate conclusions. There is but little similarity in the snake and the eel except in the external form of the body: the important internal organs of the two animals, and the character of the skeleton, are most decidedly different.

Eels are in reality a valuable description of fish: their flesh is excellent as food; they are very numerous, very prolific, and are found in almost every part of the world. The various species are hardy, tenacious of life, and very easily preserved. In this country they inhabit almost all our rivers, lakes, and ponds; they are in great esteem for the table, and the consumption in our large cities is very considerable. The London market is principally supplied from Holland by Dutch fishermen. There are two companies in Holland, having five vessels each: their vessels are built with a capacious well, in which large quantities of eels are preserved alive till wanted. One or more of these vessels may be constantly seen lying off Billingsgate; the others go to Holland for fresh supplies, each bringing a cargo of 15,000 to 20,000 pounds' weight of live eels, for which the Dutch merchant pays a duty of £13 per cargo for his permission to sell. Eels and salmon are the only fish sold by the pound weight in the London market.

Eels are not only numerous, but they are also in great request, in many other countries. Ellis, in his Polynesian Researches, vol. ii. page 286, says: "In Otaheite, eels are great favourites, and are tamed and fed until they attain an enormous size. These pets are kept in large holes, two or three feet deep, partially filled with water. On the sides of these pits they generally remained, excepting when called by the person who fed them. I have been several times with the young chief, when he has sat down by the side of the hole, and, by giving a shrill sort of whistle, has brought out an enormous eel, which has moved about the surface of the water, and eaten with confidence out of its master's hand."

"Most of the writers on the habits of the eel have described them as making two migrations in each year: one in the autumn *to* the sea; the other in spring, or at the beginning of summer, *from* the sea. The autumn migration is performed by adult eels, and is believed to be for the purpose of depositing their spawn; it is also said that these parent fish never return up the rivers. The spring migration is commonly supposed to be confined to very small eels, not more than three inches in length, and in reference to the fry alone, it is too well known, and too often recorded, to be matter of doubt. The passage of countless hundreds of young eels has been seen and described as occurring in the Thames, the Severn, the Parrett, the Dee, and the Ban. I am, however, of opinion, that the passage of adult eels to the sea, or rather to the brackish water of the estuary, is an exercise of choice, and not a matter of necessity; and that the parent eels return up the river as well as the fry."

"All authors agree that eels are extremely averse to cold. There are no eels in the arctic regions,—none in the rivers of Siberia, the Wolga, the Danube, or any of its tributary streams; yet the rivers of the southern parts of Europe produce four species. There is no doubt that fishes in general, and eels in particular, are able to appreciate even minute alterations in the temperature of the water they inhabit. The mixed water they seek to remain in during the colder months of the year is of a higher temperature than the pure fresh water of the river, or that of the sea. It is a well-known law in chemistry, that when two fluids of different densities come in contact, the temperature of the mixture is elevated for a time in proportion to the difference in density of the two fluids, from the mutual penetration and condensation. Such a mixture is constantly taking place at the mouths of rivers that run into the sea, and the mixed water maintains a temperature two degrees warmer than that of the river or the sea. This elevation in the temperature of the water of estuaries and the mouths of rivers is, I have no doubt, one reason why they in general abound in young fish."

In a tideway river the descent of the eels towards the brackish water takes place during the autumn, and various devices are employed in different streams to intercept them in their progress. One apparatus used in various parts of the Thames, called an eelbuck, consists of a framework of wood supporting various wicker-baskets of a particular form. The large open end of each basket is opposed to the stream, and by the peculiar structure of the inside, any fish once within the body of the basket, cannot escape.

During the cold months of the year eels remain imbedded in mud; and large quantities are frequently taken by eel-spears in the soft soils of harbours and banks of rivers, from which the tide recedes, and leaves the surface exposed for several hours every day. The eels bury themselves twelve or sixteen inches deep, near the edge of the navigable channel, and generally near some of the many land-drains, the water of which continues to run in its course over the mud into the channel during the whole time the tide is out. In Somersetshire the people know how to find the holes in the banks of rivers in which eels are laid up, by the hoar-

the deviations of which from the usual form of fishes are beyond the power of words to describe, and scarcely of the pencil to draw. In this class we have the Pipe Fish, that almost tapers to a thread, and the Sun Fish, that has the appearance of a bulky head, but the body cut off in the middle; the Hippocampus, with a head somewhat like that of a horse,

frost not lying over them as it does elsewhere, and dig them out in heaps. The practice of searching for eels in mud in cold weather is not confined to this country; Dr Mitchill, in his paper on the Fishes of New York, published in the Transactions of the Literary and Philosophical Society of that city, says, "In the winter eels lie concealed in the mud, and are taken in great numbers by spears." Thus imbedded in mud, in a state of torpidity, the eel indicates a low degree of respiration. Dr Marshall Hall has shown that the quantity of respiration is inversely as the degree of irritability. With a high degree of irritability and a low respiration, co-exist—1st. The power of sustaining the privation of air and of food; 2nd. A low animal temperature; 3rd. Little activity; 4th. Great tenacity of life. All these peculiarities eels are well known to possess. The high degree of irritability of the muscular fibre explains the restless motions of eels during thunder-storms, and helps to account for the enormous captures made in some rivers by the use of gratings, boxes, and eel pots or baskets, which imprison all that enter. The power of enduring the effects of a low temperature is shown by the fact, that eels exposed on the ground till frozen, then buried in snow, and at the end of four days put into water, and so thawed slowly, discovered gradually signs of life, and soon perfectly recovered.

The mode by which young eels are produced appears to have long been a subject of inquiry, and the notions of the ancients as well as of some of the moderns were numerous and fanciful. Aristotle believed that they sprang from the mud; Pliny, from fragments which were separated from their bodies by rubbing against rocks; others supposed that they proceeded from the carcasses of animals; Helmont believed that they came from May-dew, and might be obtained by the following process:—"Cut up two turfs covered with May-dew, and lay one upon the other, the grassy sides inwards, and thus expose them to the heat of the sun; in a few hours there will spring from them an infinite quantity of eels." Horse-hair from the tail of a stallion, when deposited in water, was formerly believed to be a never-failing source of a supply of young eels. It was long considered certain that they were viviparous: this belief had its origin probably in the numerous worms that are frequently to be found in various parts of the bodies of eels, sometimes in the serous cavities, at others in the intestinal canal. Rudolphi has enumerated eight different species of entozoa common to fresh-water eels. The enormous number of young known to be produced by eels is a good negative proof that they are oviparous; viviparous fishes producing, on the contrary, but few young at a time, and these too of considerable size when first excluded. Having devoted time and attention to the close examination of numbers of eels for many months in succession, the further details of which will be found in Mr Jesse's second series of Gleanings in Natural History, I need only here repeat my belief that eels are oviparous, producing their young like other true bony fishes.

"The sexual organ consists of two long narrow sacs extending one on each side of the air-bladder throughout the whole length of the abdominal cavity, and continuing for two inches posterior to the vent. The membranes forming this tubular sac, secreting on the inner surface the milt of the male, and affording attachment for the ova in the female, are puckered or gathered along the line of junction to the peritoneal covering of the spine, and the free or loose floating edge is therefore thrown into creases or plaits like a frill. It is probably from this folded or convoluted appearance the sexual organs of the eel have frequently been called fringes. By the kindness of my friends Mr Clift and Mr Owen, of the Royal College of Surgeons, I have had the pleasure of seeing some drawings belonging to the collection of John Hunter, in which these peculiarities of the sexual organs in the eel are beautifully exhibited in various magnified representations."

Dr Mitchill of New York, whose paper on Fishes has been already referred to, says "the roes or ovaria of eels may be seen by those who will look for them in the proper season, like those of other fishes."

Eels that have lain in brackish water all the winter under the constant influence of the higher temperature of that locality, probably deposit their spawn earlier in the spring than those which have passed the winter in places from which there existed for them no possible egress. In the Mole, the Wey, the Longford river, and in some large ponds, the eels in the spring of 1833 did not deposit their spawn till near the end of April; but in two eels from Sheerness received and examined on the 18th of May, the internal appearances induced me to believe that the roes had been passed some time. How long the ova remain deposited before the young eel is produced, is, I believe, unknown. The duration of this interval is very variable in different fishes. The roe of the herring, deposited at the end of October or the beginning of November, is said to become living fry within three weeks: the ova of eels, the produce of which is very small, do not probably require a longer period. Both the parent eels and the fry occupying the brackish water appear to have the power of going either to the salt water or to the fresh without inconvenience, from the previous preparation which the respiratory organs have undergone, and many of both are found in pure sea water: the great bulk of the young, however, certainly ascend the stream of the river, and their annual appearance in certain places is looked for with some interest. The passage of young eels up the Thames at Kingston in the year 1832 commenced on the 30th of April, and lasted till the 4th of May; but I believe I am correct in stating that few young eels were observed to pass up the Thames either in the year 1834 or 1835. Some notion may be formed of the quantity of young eels, each about three inches long, that pass up the Thames in the spring, and in other rivers the beginning of summer, from the circumstance that it was calculated by two observers of the progress of the young eels at Kingston in 1832, that from sixteen to eighteen hundred passed a given point in the space of one minute of time. This passage of young eels is called eel-*fare* on the banks of the Thames,—the Saxon word signifying to go, to pass, to travel;* and I have very little doubt that the term *Elver*, in common use on the banks of the Severn for a young eel, is a modification or corruption of eel-fare.

"When the elvers appear in the Severn, they are taken in great quantities with sieves of hair-cloth, or even with a common basket, and, after being scoured and boiled, are offered for sale. They are either fried in cakes or stewed, and are accounted very delicious."

There is no doubt that eels occasionally quit the water, and when grass meadows are wet from dew, or other causes, travel during the night over the moist surface in search of frogs and other suitable food, or to change their situation. Some ponds continually produce eels, though the owners of these ponds are most desirous

* A pedestrian on the road is called "a way-faring man;" and hence, also, the price for travelling by a conveyance is called "the fare." We have also "thoroughfare," &c.

and the Water Bat, whose head can scarcely be distinguished from the body. In this class we find the Fishing Frog, which from its deformity some have called the Sea Devil; the Chimæra, the Lump Fish, the Sea Porcupine, and the Sea Snail. Of all these the history is but little known; and naturalists supply the place with description.

The Sun Fish sometimes grows to a very large size; one taken near Plymouth was five hundred weight. In form it resembles a bream, or some deep fish cut off in the middle: the mouth is very small, and contains in each jaw two broad teeth, with sharp edges: the colour of the back is dusky and dappled, and the belly is a silvery white. When boiled, it has been observed to turn to a glutinous jelly, and would most probably serve for all the purposes of isinglass, were it found in sufficient plenty.

The Fishing Frog[1] in shape very much resembles a tadpole or young frog; but then

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of keeping the water free from eels, from a knowledge of their destructive habits towards the spawn and fry of other fishes. Other ponds into which eels have been constantly introduced are obnoxious to them from some quality in the water; and they are known to leave such places during the night, and have been found, on their passage to other retreats. Dr Hastings, in his Illustrations of the Natural History of Worcestershire, says at page 134, "I will here mention a curious confirmation of the opinion in favour of the overland migration of eels. A relative of the late Mr Perrott was out in his park with his keeper near a large piece of water, on a very beautiful evening, when the keeper drew his attention to a fine eel quietly ascending the bank of the pool, and with an undulating motion making its way through the long grass: on further observation he perceived a considerable number of eels quietly proceeding to a range of stews, nearly the distance of a quarter of a mile from the large piece of water from whence they started. The stews were supplied by a rapid brook, and in all probability the instinct of the fish led them in that direction as a means of finding their way to some large river from whence their ultimate destination, the sea, might be obtained. This circumstance took place at Sandford Park, near Enstone."

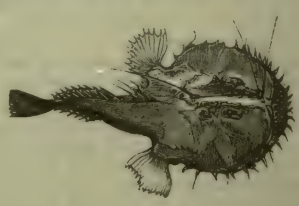
That eels breed also in the fresh water of inland rivers and lakes from which they are unable to visit the sea, is, I believe, certain. A constant supply for the table is obtained throughout the winter in these localities, as well as at other seasons, by gamekeepers and fishermen, who have charge of waters thus situated; and no doubt exists in their minds that these eels are bred in the places from which they are obtained, and of which the great variation that occurs in the size is an additional proof.

The eel is a voracious feeder during certain months of the year. In winter the stomachs of those which I examined were empty: by the middle of March I found the stomachs of others distended with the larvæ of various insects, and the bones of small fishes. They are known to consume a large quantity of spawn, and will attack large carp, seizing them by the fins, though without the power of doing them further injury. Occasionally they eat vegetable substances, and have been seen swimming about the surface of water, cropping the leaves of small aquatic plants. By means of a long and capacious air-bladder, eels rise to various elevations in the water with great ease, and sometimes swim very high even in deep water. When whitebait-fishing in the Thames, I once caught an eel in the net in twenty-six feet depth of water, though the whitebait-net does not dip more than about three feet below the surface.

Eels appear to be slow of growth, not attaining greater length than twelve inches during the first year, and do not mature roe till the second or third year. The sharp-nosed species, however, acquires a large size. I saw at Cambridge the preserved skins of two which weighed together fifty pounds; the heaviest twenty-seven pounds, the second twenty-three pounds. They were taken on draining a fen-dyke at Wisbeach.

Ely is said to have been so named from rents being formerly paid in eels: the lords of manors in the isle were annually entitled to more than 100,000 eels. A stich or stick of eels was twenty-five; and the practice of stringing eels on tough slender willow-twigs, put in at the gill-aperture and out at the mouth, still prevails in Dorsetshire among those who carry eels about for sale from house to house; one, two, or three pounds' weight being thus strung on a stick, to suit different customers. Elmore on the Severn obtained its name from the immense number of eels which are taken there.—*Yarrell's British Fishes, vol. II.*

[1] The *Fishing-Frog, Angler, Sea-Devil,* or *Wide-Gab.*—This fish, (says Mr Yarrell) which is not uncommon in all the seas of Europe, and was in consequence



called *Lophius Europæus* by Shaw, has also been called frog and frog-fish from the earliest time, from its resemblance to a frog in the tadpole state. Its habits appeared to the fishermen of former days so exact a representation of the art themselves practised that they by common consent called it the Fisher. Aristotle calls it a sort of frog, which, he says, is also called a fisher; and he adds, that this fish owes its name to the tact and industry it exercises to procure food. This fish has been taken on the coast of Londonderry, Antrim, Dublin, Waterford, and Cork, in Ireland; in England, on the coasts of Cornwall, Devonshire, Norfolk, and Yorkshire; in Scotland, in the Forth and among the Northern islands. It is also named by authors as common on the shores of the Baltic and Norway.

In its appetite this fish is most voracious; and as it is not a rapid swimmer, possessing but little power in its pectoral fins, it is supposed to be obliged to have recourse to art in order to satisfy its appetite. Upon the head, as will be seen in the figure, are two slender elongated appendages, the first of them broad and flattened towards the end, and having at this dilated part a shining silvery appearance. These elongated filaments are curiously articulated at the base with the upper surface of the head. They have great freedom of motion in any direction, the first filament more especially, produced by numerous muscles, amounting, according to M. Bailly, to twenty-two.

These elongated shafts are formed of bone covered by the common skin; and as the soft parts are abundantly supplied with nerves, they may also serve the angler as delicate organs of touch. The uses to which they are applied are singular. While couching close to the ground, the fish, by the action of its ventral and pectoral fins,

a tadpole of enormous size, for it grows to above five feet long, and its mouth is sometimes a yard wide. Nothing can exceed its deformity. The head is much bigger than the whole body; the under jaw projects beyond the upper, and both are armed with rows of slender sharp teeth: the palate and the tongue are furnished with teeth in like manner: the eyes are placed on the top of the head, and are encompassed with prickles: immediately above the nose, are two long beards or filaments, small in the beginning, but thicker at the end, and round: these, as it is said, answer a very singular purpose; for being made somewhat resembling a fishing-line, it is asserted, that the animal converts them to the purposes of fishing. With these extended, as Pliny asserts, the fishing frog hides in muddy waters, and leaves nothing but the beards to be seen: the curiosity of the smaller fish brings them to view these filaments, and their hunger induces them to seize the bait; upon which the animal in ambush instantly draws in its filaments, with the little fish that had taken the bait, and devours it without mercy. This story, though apparently improbable, has found credit among some of our best naturalists; but what induces me to doubt the fact is, that there is another species of this animal, that has no beards, which it would not want if they were necessary to the existence of the kind. Rondeletius informs us, that if we take out the bowels, the body will appear with a kind of transparence; and that if a lighted candle be placed within the body, as in a lantern, the whole has a very formidable appearance. The fishermen, however, have in general a great regard for this ugly fish, as it is an enemy to dog-fish, the bodies of those fierce and voracious animals being often found in its stomach; whenever they take it, therefore, they always set it at liberty.

The Lump Fish is trifling in size, compared to the former; its length is but sixteen inches, and its weight about four pounds; the shape of the body is like that of a bream, deep, and it swims edgeways; the back is sharp and elevated, and the belly flat; the lips, mouth, and tongue of this animal, are of a deep red; the whole skin is rough, with bony knobs; the largest row is along the ridge of the back; the belly is of a bright crimson colour: but what makes the chief singularity in this fish, is an oval aperture in the belly, surrounded with a fleshy soft substance that seems bearded all round; by means of this part it adheres with vast force to any thing it pleases. If flung into a pail of water, it will stick so close to the bottom, that on taking the fish by the tail, one may lift up pail and all, though it holds several gallons of water. Great numbers of these fish are found along the coasts of Greenland in the beginning of summer, where they resort to spawn. Their roe is remarkably large, and the Greenlanders boil it to a pulp for eating. They are extremely fat, but not admired in England, being both flabby and insipid.

The Sea Snail takes its name from the soft and unctuous texture of its body, resembling the snail upon land. It is almost transparent, and soon dissolves and melts away. It is but a little animal, being not above five inches

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stirs up the sand or mud: hidden by the obscurity thus produced, it elevates these appendages, moves them in various directions by way of attraction as a bait, and the small fishes approaching either to examine or to seize them, immediately become the prey of the fisher.

Numerous are the writers who have borne their testimony to this habit, and some have extolled it as raising the intellectual character of this fish beyond that of most of its class. Half the animal world seem destined to destroy each other, some by open violence, others by stratagem; and this design in the angler, though singular, is not more wonderful than that of the spiders among insects, who spin and repair their widely-spread webs to catch other insects upon which they subsist.

The angler has been known to measure five feet in length, but the most common size is about three feet. Mr Couch says, "It makes but little difference what the prey is, either in respect of size or quality. A fisherman had hooked a cod-fish, and while drawing it up he felt a heavier weight attach itself to his line: this proved to be an angler of large size, which he compelled to quit its hold by a heavy blow on its head, leaving its prey still attached to the hook. In another instance, an angler seized a conger eel that had taken the hook; but after the latter had been engulphed in the enormous jaws—and perhaps stomach, it struggled through the gill-aperture of the angler, and in that situation both were drawn up together. I have been told of its swallowing the large ball of cord employed as a buoy to a bulter, or deep-sea line; and the fact this implies of its mounting to the surface is further confirmed by the evidence of sailors and fishermen, who have seen it floating, and taken it with a line at mid-water. These fishes sometimes abound, and a fisherman who informed me of the circumstance found seven of them at one time on the deck of a trawl-boat: on expressing his surprise at the number, he was told that it was not uncommon to take a dozen at once."—*Couch*.

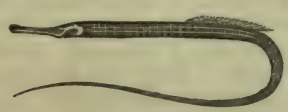
"When this fish is taken in a net, its captivity does not destroy its rapacious appetite, but it generally devours some of its fellow-prisoners, which have been taken from the stomach alive, especially flounders. It is not so much sought after for its own flesh, as for the fish generally to be found in its stomach: thus, though the fishermen reject the fish itself they do not reject those that the fish has collected."

"A female examined measured three feet three inches, the breadth across the body at the pectoral fins fifteen inches. Within the teeth, on the lower jaw, is a loose skin of a brown colour, like the back of the fish, forming a sort of bag, which probably assists in preventing the escape of its smaller prey. A male examined was three feet five inches long. When this fish was suspended by the head, the contents of its stomach were readily seen, and I perceived several cuttle-fish. The sexes are distinctly marked by external appendages, as in some species of *Raia*."—*Montagu*.

long. The colour, when fresh taken, is of a pale brown, the shape of the body round, and the back fin reaches all the way from the head to the tail. Beneath the throat is a round depression, of a whitish colour, surrounded by twelve brown spots, placed in a circle. It is taken in England at the mouth of rivers, four or five miles distant from the sea.

The body of the Pipe Fish, in the thickest part, is not thicker than a swan-quill, while it is above sixteen inches long. This is angular, but the angles being not very sharp, they are not discernible until the fish is dried. Its general colour is an olive-brown, marked with numbers of bluish lines, pointing from the back to the belly. It is viviparous; for on crushing one that was just taken, hundreds of very minute young ones were observed to crawl about.[1]

[1] There are several varieties of pipe fish, such as the *Great Pipe Fish*, (for which see Plate XXII. fig. 3.) the *Deep Nosed Pipe Fish*, the *Worm Pipe Fish*, the *Snake Pipe Fish*, &c. The following cut represents the *Snake Pipe Fish*.



The *Hippocampus* is a species of Pipe Fish of singular construction. The following represents its figure. It



is about five inches long. For *Hippocampus foliatus*, see Plate XXII. fig. 10.

The *Gar Fish*.—The Gar Fish belongs to the class of needle fish, which denomination they have received from the extreme length of their bodies in proportion to their thickness. They have no scales, but scuta or bucklers, with several angles. The hexagonal form of the body and the anal fin, are the distinguishing characters of the gar fish. The body is composed of eighteen scuta, and the tail of thirty-six, which form as many joints; the tail is square. It is found in the North and Baltic seas; it scarcely exceeds the length of a foot, and the thickness of a finger. Besides the appellation of needle fish and gar fish, it is sometimes called by that of a shorter pipe and horn fish.

The *Needle Fish* are natives of the ocean, and the North and Baltic seas. They are usually found in deep places near the coasts, where they are caught with other fish. They produce their young in a perfect state, one after the other, from eggs hatched in their bodies, like the sharks and rays. Having but little flesh they are fit only for baiting lines; and they are the more proper for this purpose as they are tenacious of life: and it is well known that fish bite more eagerly at a living bait than a dead one.

The Hippocampus, which, from the form of its head, some call the seahorse, never exceeds nine inches in length. It is about as thick as a man's thumb, and the body is said, while alive, to have hair on the fore-part, which falls off when it is dead. The snout is a sort of a tube with a hole at the bottom, to which there is a cover, which the animal can open and shut at pleasure. Behind the eyes there are two fins which look like ears; and above them are two holes which serve for respiration. The whole body seems to be composed of cartilaginous rings, on the intermediate membranes of which several small prickles are placed. It is found in the Mediterranean, and also in the Western ocean; and, upon the whole, more resembles a great caterpillar than a fish. The ancients considered it as extremely venomous; probably induced by its peculiar figure.

From these harmless animals, covered with a slight coat of mail, we may proceed to others, more thickly defended, and more formidably armed, whose exact station in the scale of fishes is not yet ascertained. While Linnæus ranks them among the cartilaginous kinds, a

The *Sea Adder*, or little pipe, is nearly round, having only some very small and scarcely perceptible angular projections on the sides. It has but one fin; and the body is divided into joints, like that of the common worm. It grows to the length of two feet, and is not thicker than a swan's quill. It inhabits the North and Baltic seas, and is of the same nature as the two former fish.

The *Long File Fish*.—The body of the long file fish is not very deep; the skin is divided by smooth furrows, with small rough scale-like spaces: each of these, on the sides, have a small spine pointing towards the tail; the first dorsal fin has three spines, the first of which is very large, and rough in front like a file, and hence the English name; the third very short, and situated at a considerable distance from the other two; the skin at the back and belly, at the base of the dorsal and anal fins drawn out and compressed; pectoral fins small; dorsal and anal fins triangular, and situated nearly opposite each other; the tail even at the end. A singular property is possessed by the first dorsal fin of this fish, which is, that no force can depress the first spine; but if the last be depressed in ever so gentle a manner, the other two immediately fall down upon it, and as instantaneously as when a cross-bow is let off by pulling the trigger. One sort found in the Mediterranean, near Rome, is on that account called *pisce balestra*, the cross-bow fish.

There is another species, mentioned by Walcott, the body of which is much compressed and deep; the rays of the dorsal fin, spiny; the first ray very long and rough; first dorsal fin, and the back from its base, black; skin rough; tail rough; and in the place of each ventral fin a long rough spine. Also another species, (named *hispidus* by naturalists,) is found in Carolina; the head fin of which is not radiated, and there is a round black spot in the tail fin. The body is rough, and bristly towards the tail. The spine, or horn, is situated between the eyes; and instead of a belly fin it has a jagged sharp spine. Several more species, or varieties, are found in the Indian ocean, and at Ascension island, all which, together with the unicorn, go by the general name of the belestes. For common file fish, see Plate XXI. fig. 22

later naturalist places them among the spinous class. With which tribe they most agree, succeeding observations must determine. At present we seem better acquainted with their figure than their history: their deformity is obvious; and the venomous nature of the greatest number has been confirmed by fatal experience.—This circumstance, as well as the happy distance at which they are placed from us, being all found in the Oriental or American seas, may have prevented a more critical inquiry; so that we know but little of the nature of their malignity, and still less of their pursuits and enmities in the deep.

In the first of this tribe we may place the Sea Orb, which is almost round, has a mouth like a frog, and is from seven inches to two feet long. Like the porcupine, from whence it sometimes takes its name, being also called the Sea Porcupine, it is covered over with long thorns or prickles, which point on every side; and, when the animal is enraged, it can blow up its body as round as a bladder. Of this extraordinary creature there are many kinds: some threatening only with spines, as the Sea Hedgehog; others defended with a bony helmet that covers the head, as the Ostracion; others with a coat of mail from the head to the tail, where it terminates in a point, as the Centriscus; and others still armed offensively and defensively with bones and spines, as the Shield Orb.[1]

Of these scarcely one is without its peculiar weapon of offence. The centriscus wounds with its spine; the ostracion poisons with its venom; the orb is impregnable, and is absolutely poisonous if eaten. Indeed, their figure is not such as would tempt one to make the experiment; and the natives of those countries where they are found, are careful to inform foreigners of their danger: yet a certain sailor at the Cape of Good Hope, not believing what the Dutch told him concerning their venom, was resolved to make the experiment, and break through a prejudice, which, he supposed, was founded on the animal's deformity. He tried, and ate one; but his rashness cost him his life; he instantly fell sick, and died a few days after.

These frightful animals are of different sizes; some not bigger than a foot-ball, and others as large as a bushel. They almost all flatten and erect their spines at pleasure, and increase the terrors of their appearance in proportion to the approach of danger. At first they seem more inoffensive; their body oblong, with all their weapons pointing towards the tail; but, upon being provoked or alarmed, the body, that before seemed small, swells to the view; the animal visibly grows rounder and larger, and all its prickles stand upright, and threaten the invader on every side. The Americans often amuse themselves with the barren pleasure of catching these frightful creatures by a line and hook, baited with a piece of sea-crab. The animal approaches the bait with its spines flattened; but when hooked and stopped by the line, straight all its spines are erected; the whole body being armed in such a manner at all points, that it is impossible to lay hold of it on any part. For this reason it is dragged to some distance from the water, and there it quickly expires. In the middle of the belly of all these there is a sort of bag or bladder filled with air, and by the inflation of which the animal swells itself in the manner already mentioned.

In describing the deformed animals of this

[1] The *Eared Ostracion* (See Plate XXI. fig. 21.)—This fish has a brown spine over each eye, two on each side of the back, the same on each side of the abdomen, and one on each side of the body. Its teeth are cylindrical, blunt, and pointing forwards. The whole body is mailed with a complete bony covering. This species is found about the islands of the Pacific ocean, and is readily distinguished from the rest of its cogeners. Its length is about four inches and a half. (For *Ostracion turritus*, see Plate XXII. fig. 13.)

The *Lineated Tetrodon*.—The jaws are bony, and divided at the tip; the body is roughened beneath, and the ventral fins wanting; the abdomen is variegated by longitudinal brown bands. This singular fish, which is a native of the Mediterranean sea, is also said to be sometimes found in the river Nile. Like many others of its genus, it has a power of inflating at pleasure the skin of its body; and being covered on the abdomen with numerous small spines, is said to inflict considerable pain on the hands of those who incautiously touch it. It grows to the length of from eight to ten inches. (For *Tetrodon hispidus*, see Plate XXI. fig. 4.)

The *Orbicular Diadon*.—This remarkable fish grows about a foot in length, and is a native of the tropical seas. It is of a rounder shape than the *Diadon Hystriæ*, or *Porcupine Diadon*; (for which see Plate XXII. fig. 17.) its jaws are bony, and undivided; and the body beset with movable spines. The spines are much shorter than the porcupine diadon, with broader bases, forming a kind of curved reticular pattern on the skin.

The *Scaly Centriscus*.—The head of this fish is produced into a very narrow snout; its mouth is toothless, with the lower jaw longer than the upper one. The gill-openings are wide; its body is compressed, with the abdomen carinated; and the ventral fins united. The Scaly Centriscus or Bellows Fish is a native of the Mediterranean sea, and grows to the length of five or six inches: it feeds on worms, and the smaller kinds of marine insects.

The *Telescope Fish*.—The whole body of this fish, and the ground colour of the fins, is of a beautiful red, darker towards the back, and lighter towards the belly: the membranes of the fins are almost white; and the red rays shining through them have a very fine effect; the three white points of the tail give you an idea of a trident or tulip. The head is short, but large; the mouth is small; the nostrils single. The pupil of the eye is black, the iris yellow; the back is round; the lateral line nearer the back than the head. The scales on the belly are large; the rays of the fins are ramified. This beautiful fish is found in the fresh waters of China, and is supposed to be a variety of the gold fish.

class, one is sometimes at a loss whether it be a fish or an insect that lies before him. Thus the hippocampus and the pipe-fish bear a strong resemblance to the caterpillar and the worm; while the lesser orb bears some likeness to the class of sea-eggs to be described after. I will conclude this account of cartilaginous fishes with the description of an animal which I would scarcely call a fish, but that Father Labat dignifies it with the name. Indeed, this class teems with such a number of odd-shaped animals, that one is prompted to rank every thing extraordinary of the finny species among the number: but besides, Labat says, its bones are cartilaginous, and that may entitle it to a place here.

The animal I mean is the Galley Fish, which Linnæus degrades into the insect tribe, under the title of *the medusa*, but which I choose to place in this tribe, from its habits, that are somewhat similar. To the eye of an unmindful spectator, this fish seems a transparent bubble swimming on the surface of the sea, or like a bladder variously and beautifully painted with vivid colours, where red and violet predominate, as variously opposed to the beams of the sun. It is, however, an actual fish; the body of which is composed of cartilages, and a very thin skin filled with air, which thus keeps the animal floating on the surface, as the waves and the winds happen to drive. Sometimes it is seen thrown on the shore by one wave, and again washed back into the sea by another. Persons who happen to be walking along the shore often happen to tread upon these animals; and the bursting of their body yields a report like that when one treads upon the swim of a fish. It has eight broad feet, with which it swims, or which it expands to catch the air as with a sail. It fastens itself to whatever it meets by means of its legs, which have an adhesive quality. Whether they move when on shore, Labat could never perceive, though he did every thing to make them stir; he only saw that it strongly adhered to whatever substances he applied it. It is very common in America, and grows to the size of a goose-egg, or somewhat more. It is perpetually seen floating; and no efforts that are used to hurt it can sink it to the bottom. All that appears above water is a bladder clear and transparent as glass, and shining with the most beautiful colours of the rainbow. Beneath, in the water, are four of the feet already mentioned, that serve as oars, while the other four are expanded above to sail with. But what is most remarkable in this extraordinary creature, is the violent pungency of the slimy substance with which its legs are smeared. If the smallest quantity but touch the skin, so caustic is its quality, that it burns it like hot oil dropped on the part affected. The pain is worst in the heat of the day, but ceases in the cool of the evening. It is from feeding on these that he thinks the poisonous quality contracted by some West Indian fish may be accounted for. It is certain these animals are extremely common along all the coasts in the gulf of Mexico; and whenever the shore is covered with them in an unusual manner, it is considered as a certain forerunner of a storm.[1]

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[1] The *Remora* or *Sucking-Fish*. (See Plate XXI. fig. 16.)—This extraordinary fish is furnished with a most peculiar apparatus, on the crown of its head, by which it is enabled at will to fix itself firmly to any other body. For what purpose this uncommon arrangement of parts has been bestowed on it, we have no certain means of judging; for the wonders of the deep are but partially unfolded to our view, and the deep recesses of its caves, the feeding-grounds of fish, are completely out of our reach. We may, however, by observing the peculiar formation of the remora, make some reasonable conjecture at the intention of Providence in thus departing from its ordinary course.

The small size of the fins in this fish, take away from it the power of rapid motion; it may therefore be supposed, that at times it fixes itself to the moving bodies, such as ships, or larger fish, on which it is frequently found, for the purpose of rest, or to help it more rapidly onward in its course. It may also feed, in one instance, on substances thrown overboard by the sailors, and in the other, on such portions of food as its larger companion rejects or lets slip. In addition to this, the power of attaching itself to rocks or other fixed bodies at the bottom of the sea, while waiting for the passing by of any small object on which it can prey, will, no doubt, at times, be of great advantage to its possessor.

A foolish idea prevailed, in former times, that when this fish attached itself in great numbers to the bottoms of vessels, it impeded, or even stopped them in their course, and many fabulous tales have been told to that effect. If no other object has been gained, by the study of natural history, than the removal of such simple prejudices, which would seem to imply that one part of the creation was made for the useless destruction of another, still that study would be a useful object of cultivation.

A

HISTORY OF FISHES.

BOOK III.

OF SPINOUS FISHES.

CHAP. I.

THE DIVISION OF SPINOUS FISHES.

The third general division of fishes is into that of the spinous or bony kind. These are obviously distinguished from the rest by having a complete bony covering to their gills; by their being furnished with no other method of breathing but gills only; by their bones, which are sharp and thorny; and their tails, which are placed in a situation perpendicular to the body. This is that class which alone our later naturalists are willing to admit as fishes. The cetaceous class with them are but beasts that have taken up their abode in the ocean; the cartilaginous class are an amphibious band, that are but half denizens of that element: it is fishes of the spinous kind that really deserve the appellation.

This distinction the generality of mankind will hardly allow; but whatever be the justice of this preference in favour of the spinous class, it is certain that the cetaceous and cartilaginous classes bear no proportion to them in number. Of the spinous classes are already known above four hundred species; so that the numbers of the former are trifling in comparison, and make not above a fifth part of the finny creation.

From the great variety in this class, it is obvious how difficult a task it must have been to describe or remember even a part of what it contains. When six hundred different sorts of animals offer themselves to consideration, the mind is bewildered in the multiplicity of objects that all lay some claim to its attention. To obviate this confusion, systems have been devised, which, throwing several fishes that agree in many particulars into one group, and thus uniting all into so many particular bodies, the mind that was incapable of separately considering each, is enabled to comprehend all, when thus offered in larger masses to its consideration.

Indeed, of all the beings in animated nature, fishes most demand a systematical arrangement. Quadrupeds are but few, and can be all known; birds, from their seldom varying in their size, can be very tolerably distinguished without system; but among fishes, which no size can discriminate, where the animal ten inches, and the animal ten feet long, is entirely the same, there must be some other criterion by which they are to be distinguished; something that gives precision to our ideas of the animal whose history we desire to know.

Of the real history of fishes, very little is yet known; but of very many we have full and sufficient accounts, as to their external form. It would be unpardonable, therefore, in a history of these animals, not to give the little we do know; and, at least, arrange our forces, though we cannot tell their destination. In this art of arrangement, Artedi and Linnæus have long been conspicuous: they have both taken a view of the animal's form in different lights; and, from the parts which most struck them, have founded their respective systems.

Artedi, who was foremost, perceiving that some fishes had prickly fins, as the pike; that others had soft pliant ones, as the herring; and that others still wanted that particular fin by which the gills are opened and shut, as the eel, made out a system from these varieties. Linnæus, on the other hand, rejecting this system, which he found liable to too many exceptions, considered the fins not with regard to their substance, but their position. The ventral fins seem to be the great object of his system; he considers them in fishes supplying the same offices as feet in quadrupeds; and

from their total absence, or from their being situated nearer the head or the tail, in different fishes, he takes the differences of his system.

These arrangements, which are totally arbitrary, and which are rather a method than a science, are always fluctuating; and the last is generally preferred to that which went before. There has lately appeared, however, a system composed by Mr Gouan, of Montpellier, that deserves applause for more than its novelty. It appears to me the best arrangement of this kind that ever was made; and in it the divisions are not only precisely systematical, but, in some measure, adopted by Nature itself. This learned Frenchman has united the systems of Artedi and Linnæus together; and, by bringing one to correct the other, has made out a number of tribes that are marked with the utmost precision. A part of this system, however, we have already gone through in the cartilaginous, or, as he calls a part of them, the *branchiostegous* tribe of fishes. In the arrangement of these, I have followed Linnæus, as the number of them was but small, and his method simple. But in that which is more properly called the *spinous class of fishes,* I will follow Mr Gouan's system; the terms of which, as well as of all the former systems, require some explanation. I do not love to multiply the technical terms of a science; but it often happens that names, by being long used, are as necessary to be known as the science itself.

If we consider the substance of the fin of a fish, we shall find it composed, besides the skin, either of straight, hard, pointed, bony prickles or spines, as in the pike; or of soft, crooked, or forked bones, or cartilages, as in the herring.—The fish that have bony prickly fins, are called *prickly-finned fish;* the latter, that have soft, or cartilaginous fins, are called *soft-finned fish.* The prickly-finned fish have received the Greek new-formed name of *Acanthopterigii;* the soft-finned fish have likewise their barbarous Greek name of *Malacopterigii.* Thus far Artedi has supplied Mr Gouan with names and divisions. All spinous fish are divided into prickly-finned fish and soft-finned fish.

Again, Linnæus has taught him to remark the situation of the fins; for the ventral, or belly-fins, which are those particularly to be remarked, are either wholly wanting, as in the eel, and then the fish is called *Apodal* (a Greek word, signifying without feet); or the ventral fins are placed more forward than the pectoral fins, as in the haddock, and then the animal is a *Jugular-fish;* or the ventral fins are placed directly under the pectoral fins, as in the father-lasher, and then it is called a *Thoracic-fish;* or, lastly, the ventral fins are placed nearer the tail than the pectoral fins, as in the minnow, and then it is an *Abdominal-fish.*

Possessed of these distributions, the French naturalist mixes and unites them into two grand divisions. All the prickly-finned fish make one general division; all the soft-finned fish another. These first are distinguished from each other, as being either *apodal, jugular, thoracic,* or *abdominal.* Thus there are prickly-finned *apodal* fishes; prickly-finned *jugular* fishes; prickly-finned *thoracic* fishes; and prickly-finned *abdominal* fishes. On the other hand, the soft-finned fishes fall under a similar distribution, and make the other general division. Thus there are soft-finned *apodal* fishes, soft-finned *jugular* fishes, soft-finned *thoracic* fishes, and soft-finned *abdominal* fishes. These general characters are strongly marked, and easily remembered. It only remains, therefore, to divide these into such tribes as are most strongly marked by nature; and to give the distinct characters of each to form a complete system with great simplicity. This Mr Gouan has done; and the tribes into which he has distributed each of these divisions, exactly amount to fifty. Thus the reader, who can contain in his memory the characteristic marks of fifty kinds, will have a tolerable idea of the form of every kind of spinous fish. I say, of the form; for as to the history and nature of the animal itself, that can only be obtained by experience and information.

SECT. I.

PRICKLY-FINNED FISHES.

Prickly-finned Apodal Fish.

1. The *Trichurus.* The body of a sword-form; the head oblong; the teeth sword-like, bearded near the points; the fore-teeth largest; the fin that covers the gills with seven spines; the tail ending in a point without fins; an inhabitant near the Oriental and American shores; of a silvery white; frequently leaping into the fishermen's boats in China.

2. The *Xiphias,* or *Sword-fish.* The body round; the head long; the upper jaw terminating by a long beak, in form of a sword; the fin that covers the gills with eight spines; an inhabitant of Europe; an enemy to the whale.[1]

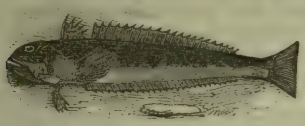
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[1] The general colour of the common sword-fish (*xiphias gladius,* see Plate XXI. fig. 11.) is brown, accompanied by a deep steel-blue cast on the head and upper parts, and inclining to silvery white on the sides and abdomen. It sometimes grows to a very large size, and as much as twenty feet in length. Pennant mentions one cast on shore near Laugharne, Caermarthenshire,

3. *Ophidium* or *Gilthead.* The body sword-like; the head blunt; the fin covering the gills with seven spines; the opening of the mouth side-ways; the fins of the back, the anus, and the tail, all joining together; the most beautiful of all fishes, covered over with green, gold, and silver; it is by sailors called the dolphin, and gives chase to the flying-fish.

Prickly-finned Jugular Fish.

4. The *Trachinus* or *Weever.* The body oblong; the head obtuse; the bones covering



the gills jagged at the bottom; the fins covering the gills with six spines; the anus near the breast; buries itself in the sands, leaving only its nose out; and if trod upon, immediately strikes with the spines that form its dorsal fins, which are venomous and dangerous.

5. The *Uranoscopus.* The body wedge-like; the head almost round, and larger than the body; the mouth flat; the eyes on the top of the head; the fin covering the gills with six spines; the anus in the middle of the body; an inhabitant of the Mediterranean sea.

6. *Callyonymus* or *Dragonet.* The body almost wedge-like; the head broad, and larger than the body; the mouth even with the body; the bony covering of the gills close shut; the opening to the gills behind the head; the fin covering the gills with six spines; an inhabitant of the Atlantic ocean.

7. The *Blennius* or *Blenny.* The body oblong; the head obtusely bevel; the teeth a single range; the fin covering the gills with six spines; the ventral-fins have two small blunt bones in each; a species of this animal is viviparous.

Prickly-finned Thoracic Fish.

8. The *Gobius* or *Gudgeon.* The body round and oblong; the head with two little



holes between the eyes, one before the other; the fin covering the gills with four spines; the ventral fins joined together.

9. The *Cepola.* The body sword-like; the head blunt; the mouth flat; the fin covering the gills with six spines; the fins distinct; an inhabitant of the Mediterranean sea.

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the head of which alone weighed seventy-five pounds, and was furnished with a snout three feet long. The sword-fish is very active in its movements and voracious in its appetite. It feeds on the smaller kinds of fish, which it kills by piercing them with its sword. It is said to be in particular a very great enemy to the tunny, which is described by Belon to be as much alarmed by its appearance as a sheep is at the sight of a wolf.

This fish is highly esteemed as an article of food by the Sicilians, who buy it up eagerly at any price at the commencement of the season, which lasts from May to August. They cut it into pieces, and salt it for future use. This process was in ancient times particularly performed at the town of Thuri in the bay of Tarentum, whence the fish was called *tonus thurianus.* A description of the ancient manner of taking this fish has been left us by Strabo, from which it appears that the process was the same as that now in use. The operation resembles whale fishing on a small scale.

The broad-finned sword-fish (*xiphias platypterus*) is of a thinner and more elegant form than the preceding, and is also distinguished by an extremely broad back fin, and by very long sharp-pointed thoracic appendages, which are entirely wanting in the other. The general colour of the fish is of a silvery-bluish white, except in the back, head, tail, and fins, which in the living animal are of a deep blue, fading into brown in the dried specimens. This fish is found in the Brazilian and East Indian seas, and also in the Northern seas, where and elsewhere it is a great enemy to whales, piercing them with its formidable weapon. A specimen of this fish occupies a very conspicuous situation at the British Museum in a distinct case, which also contains three specimens of detached swords. In the same room there is a small specimen of the common sword-fish.

The captain of an East Indiaman sent to Sir Joseph Banks an account of an astonishing but not singular instance of the strength of an individual of this broad-finned species: the bottom of his ship was pierced through by its sword in such a manner that it was completely imbedded, or driven through almost to its base,—the animal having been killed with the violence of the shock. It is a fortunate circumstance that the fish is generally either killed in this manner or else perishes from being unable to withdraw its weapon, for could it effect this object, the vessel must inevitably founder in consequence of the leak; and indeed instances are recorded in which some vessels, probably old or of a slight description, have been greatly endangered, or even lost, in consequence of having been struck by a sword-fish. In the present instance, the wood, with the sword imbedded in it, was sawed out, and is now in the British Museum, where it forms one of the detached swords just mentioned.

The sword-fish and the whale are said never to meet without coming to battle; and the former has the repute of being always the aggressor. Sometimes two of them join against one whale, in which the combat is by no means equal. When the whale discovers the sword-fish darting upon him, he dives to the bottom, but is closely pursued by his antagonist, who compels him again to rise to the surface. It would seem that the sword-fish aims its formidable thrusts at vessels, not so much from a disposition to attack every thing that falls in its way as under the impression that the said vessels are whales, or other great fish: and may not the fact, that vessels are rarely if ever so attacked in the Mediterranean, be in a great degree owing to this,—that there are not in that sea any fish so large that a sword-fish of ordinary penetration could mistake a ship for them.

10. The *Coryphæna* or *Razor-fish.* The body wedge-like; the head very bevel; the fin covering the gills with five spines.

11. The *Skomber* or *Mackerel.* The body oblong; the line running down the side zig-zagged towards the tail; the head sharp and small; the fins covering the gills with seven spines; several false fins towards the tail.[1]

12. The *Labrus.*Pl.XXI.fig.23. The body oval; the head middling; the lips doubled inward; both cutting and grinding teeth; the covers of the gills scaly; the fin covering

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[1] The *Mackerel,* (*Scomber scombrus,*)—The mackerel,



though of the same *order* as the herring, pilchard, and sprat, belongs to a distinct *family,*—to which also belong the tunny, the bonito, the sword-fish, the dory, or doree, and several other kinds. The mackerel, which is placed at the head of this division of acanthopterygii, was known to the Greeks by the name of σκομβρος (*scombros*); and the generic term for all fish comprised in this class is *Scomberidæ.* The name given to the mackerel by the French, German, and Dutch, as well as by the British, is derived from the Latin word *macula,* a spot; that is, the spotted or streaked fish. Hence the term "mackerel-sky" is also applied to a well-known formation of the clouds. The mackerel is perhaps the most beautiful of our British fishes, being elegant in its form as well as brilliant in colour.

For the following account of the habits and mode of taking this useful fish, we are indebted to the elegant and valuable *History of British Fishes,* by Mr Yarrell.

On the coast of Ireland, the mackerel is taken from the county of Kerry in the west, along the southern shore, eastward to Cork and Waterford; from thence northward to Antrim, and north-west to Londonderry and Donegal. Dr Macculloch says it visits some of the lochs of the western islands, but is not considered very abundant. On the Cornish coast, this fish occurs sometimes as early as March, and appears to be pursuing a course from west to east. They are plentiful on the Devonshire coast, and swarm in West bay about June. On the Hampshire and Sussex coast, particularly the latter, they arrive as early as March, and sometimes, as will be shown, even in Feburary; and the earlier in the year the fishermen go to look for them, the further from the shore do they seek for them and find them. Duhamel says the mackerel are caught earlier at Dunkirk than at Dieppe or Havre: up our eastern coast, however, the fishing is later. The fishermen of Lowestoffe and Yarmouth, gain their great harvest from the mackerel in May and June.

The mackerel spawns in June, and according to Bloch, five hundred and forty thousand eggs have been counted in one fish. The young mackerel, which are called shiners, are from four to six inches long, by the end of August. They are half grown, says Mr Couch, by November, when they retire to deep water, and are seen no more that winter; but the adult fishes never wholly quit the Cornish coast, and it is common to see some taken with lines in every month of the year. The mackerel as feeders are voracious, and their growth is rapid. The ordinary length varies from fourteen to sixteen inches, and their weight is about two pounds each; but they are said to attain the length of twenty inches. The largest fish are not, however, considered the best for the table.

As an article of food they are in great request, and those taken in the months of May and June are generally considered superior in flavour to those taken either earlier in the spring, or in autumn. To be eaten in perfection, this fish should be very fresh, as it soon becomes unfit for food. Mackerel were first allowed to be cried through the streets of London on a Sunday, in 1698, and the practice prevails to the present time.

At our various fishing-towns on the coast, the mackerel season is one of great bustle and activity; the high price obtained by early cargoes being the inducement to great exertions.

In May, 1807, the first Brighton boat-load of mackerel sold at Billingsgate for forty guineas per hundred,—seven shillings each, reckoning six score to the hundred,—the highest price ever known at that market. The next boat-load produced but thirteen guineas the hundred. Mackerel were so plentiful at Dover in 1808, that they were sold sixty for a shilling. At Brighton, in June of the same year, the shoal of mackerel was so great, that one of the boats had the meshes of her nets so completely occupied by them, that it was impossible to drag them in. The fish and nets, therefore, at length sunk together. The boats engaged in fishing, are usually attended by other fast-sailing vessels, which are sent away with the fish taken. From Hastings, and other fishing-towns on the Sussex coast, the fish are brought to London by vans, which travel up during the night.

The most common made of fishing for mackerel, and in which the greatest numbers are taken, is by drift-nets. The drift-net is twenty feet deep, by one hundred and twenty feet long, well corked at the top, but without lead at the bottom. They are made of small fine twine, which is tanned of a reddish-brown colour, to preserve it from the action of the sea water. The size of the mesh is about two and a half inches, or rather larger. Twelve, fifteen, and sometimes eighteen of these nets are attached lengthways, by tying along a thick rope called the drift-rope, and at the end of each net to each other. When arranged for depositing in the sea, a large buoy attached to the end of the drift-rope, is thrown overboard; the vessel is put before the wind, and as she sails along, the rope with the nets thus attached, is passed over the stem into the water, till the whole of the nets are run out. The net thus deposited, hangs suspended in the water perpendicularly, twenty feet deep from the drift-rope, and extending from three quarters of a mile to a mile, or even a mile and a half, depending on the number of nets belonging to the party or company engaged in fishing together. When the whole of the nets are thus handed out, the drift-rope is shifted from the stern to the prow of the vessel, and she rides by it as if at anchor. The benefit gained by the boat's hanging at the end of the drift-rope is, that the net is kept strained in a straight line, which, without this pull upon it, would not be the case.

The nets are shot in the evening, and sometimes hauled once during the night, at others allowed to remain in the water all night. The fish roving in the dark through the water, hang in the meshes of the net, which are large enough to admit them beyond the gill-covers and pectoral fins, but not large enough to allow the thickest part of the body to pass through. In the morning early, preparations are made for hauling the nets. A capstan upon the deck is manned, about which two turns of the drift-rope are taken. One man stands forward to untie the upper edge of each net from the drift-rope, which is called casting off the lashings; others hand in the net with the fish caught, to which one side of the vessel is devoted; the other side is occupied by the drift-rope, which is wound in by the men at the capstan. The whole of the net in, and the fish secured,

the gills with five spines; the pectoral fins pointed.

13. The *Sparus* or *Sea-Bream.* The body oblong; the head middling; the lips not in-



verted; the teeth cutting and grinding; the

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the vessel runs back into harbour with her fish, or deposits them on board some other boat in company.

Near to land, another mode of fishing is adopted, which is thus described by Mr Couch. "A long deep net is employed, of which, unlike the former, the meshes are too small to admit any of the fish. Two boats are necessary, one of which is rowed round the *schull*, while the net is thrown overboard by two men to enclose it: the other boat is employed in keeping steady the end of the net, and warping it, the sooner and more surely to prevent the escape of the fish. When this is effected, the net stands like a circle, enclosing the captives, and the men proceed to draw it together at the end and bottom; at the same time throwing pebbles at that place where the circle closes, to prevent the approach of the fish to the only place where escape is possible: when at last the enclosure is perfect, and the net raised from the ground, the fish thus brought to the surface are taken on board in flaskets." Such is the mode of proceeding with the seine-net in deep water, or at a distance from shore, but in some places it is hauled on the beach in the manner of a ground-net, with less trouble and expense.

A third mode of fishing is with the line, and is called railing, (*trailing.*) The mackerel will bite at any bait that is used to take the smaller kind of fish; but preference is given to that which resembles a living and active prey, which is imitated by what is called a lask,—a long slice cut from the side of one of its own kind near the tail;—it is found, also, that a slip of red leather, or a piece of scarlet cloth, will commonly succeed. The boat is placed under sail, and a smart breeze is considered favourable, hence termed a mackerel-breeze. The line is short, but weighed down by a heavy plummet, and in this manner, when these fish abound, two men will take from five hundred to a thousand a day. It is singular that the greatest number of mackerel are caught when the boat moves most rapidly, and that even then the hook is commonly gorged. It seems that the mackerel takes its food by striking across the course of what is supposed to be its flying prey.

The *Tunny.*—The common Tunny (*Thynnus vulgaris,*) is a large fish belonging to the mackerel tribe;



although but little known in England, it is an object of considerable importance to many of the nations bordering on the Mediterranean; to none more so, perhaps, than the Sicilians. The tunnies, like the mackerel, appear in great shoals, or banks, which are believed to enter the Mediterranean at the beginning of April, for the purpose of depositing their spawn; but it is very likely that instead of coming from any great distance, they

cover of the gills scaly; the fins covering the gills with five rays; the pectoral fins pointed.

14. The *Chætodon* or *Cat-fish.* The body oblong; the head small; the teeth slender and

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merely rise from the deeper parts of that sea, in order to reach the shoal water, that the spawn, or ova, may be placed within the influence of the sun's rays. The appearance of the mackerel is said to indicate the approach of the tunnies, these last being voracious fish, and devouring great quantities of their smaller brethren.

At the time when these fish make their periodical appearance, the strongest and the boldest precede their companions at distances determined by their greater vigour or courage. The form assumed by a shoal of tunnies, is that of a long triangle, the weaker fish bringing up the rear. The approach of this living mass is perceived at a considerable distance, from the noise which accompanies their rapid movements, for the tail of the tunny is large and powerful, and striking forcibly and rapidly against the water, produces a sound which can be heard at a great way off. "This murmuring noise, which is heard from afar, is echoed from rock to rock, and repeated from shore to shore, resembling that dull but imposing sound, which during a deceitful calm on a burning summer's day, announces the approach of a hurricane."

In spite, however, of their number, their strength, and their swiftness, a sudden noise will often arrest the whole shoal in the middle of their course, or even the unexpected appearance of any bright object. If we may believe the reasoning of Pliny, the Roman naturalist, who speaking of the tunny, says, "in the spring, the tunnies pass in troops, composed of numerous individuals, from the Mediterranean into the Euxine or the Black sea, and in the strait which separates Europe from Asia, a rock of dazzling whiteness, and of great elevation, rises near Chalcedony, on the Asiatic shore; and the sudden appearance of this rock, terrifies the tunnies to such an extent, as to force them to alter their course, and suddenly turn towards the Cape of Byzantium, opposite the Chalcedonian shore; and this forced direction of the course of these fish, causes the fishery to be very abundant near the Cape of Byzantium." The usual size of this fish is from two to three feet in length; they are at times, however, taken as long as ten feet. Aristotle mentions an old tunny which weighed upwards of two hundred weight.

The tunny-fishery was attended to with great care by the ancients, and still employs a vast number of hands in different parts of the Mediterranean, chiefly in Catalonia, Provence, Liguria, Sardinia, and, as we have already mentioned, Sicily.

The tunnies are taken in two ways. In the first case, when a sentinel, posted on an elevated spot, has made a signal that the fish are in view, and has pointed out the quarter from which they are coming, a number of boats put to sea under the command of a leader, and arrange themselves in a curve, and joining their nets form an enclosure, which alarms the tunnies, and gradually drives them into closer ranks: they still continue to add fresh nets, continually driving the fish towards the shore. When they have reached water only a few fathoms in depth, they cast their last and largest net, which has a kind of pocket or long bag attached to it; this they draw towards the land, and with it they bring all the fish. The small ones are then taken out with the hands, and the larger are landed after they are despatched with boat hooks. This mode of fishing, which is employed on the coast of Languedoc, produces sometimes at a single *take* as much as fifteen ton weight of fish.

The second mode is that with nets, called by the

bending; the fin covering the gills with three to six spines; the fins of the back and anus scaly.[1]

15. The *Scicena*. The body nearly elliptical; the head bevel, the covers of the fins scaly; the fin covering the gills with six rays; the fins of the back jagged, and hidden in a furrow in the back.

16. The *Perch*.[2] The body oblong; the head bevel; the covers of the gills scaly and toothed; the fin covering the gills with seven spines; the fins in some jagged.

17. The *Scorpæna* or *Father-lasher*. The body oblong; the head great, with beards; the covers of the gills armed with prickles; the fin covering the gills with seven spines.

18. The *Mullus* or *Surmulet*. The body slender; the head almost four-cornered; the fin covering the gills with three spines; some of these have beards; a fish highly prized by the Romans, and still considered as a very great delicacy.

19. The *Trigla* or the *Gurnard*. The body slender; the head nearly four-cornered, and covered with a bony coat, the fin covering the gills with seven spines; the pectoral and ventral fins strengthened with additional muscles and bones, and very large for the animal's size.

20. The *Cottus* or *Bull-head*. The body wedge-like; the head flat and broader than the body; the fin covering the gills with six spines; the head furnished with prickles, knobs, and beards.

21. The *Zeus* or *Doree*. The body oblong; the head large, bevel; the fin covering the gills with seven rays; the fins jagged; the upper-jaw with a loose floating skin depending into the mouth.

22. The *Trachipterus* or *Sabra*. The body sword-like; the head bevel; the fin covering the gills with six spines; the lateral line straight; the scales in a single order; a loose skin in both the jaws.

23. The *Gasterosteus* or *Sticklebach*. The body broadest towards the tail; the head ob-

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Italians *tonnaro*. These are much more complicated; Brydone calls the whole apparatus a kind of aquatic castle, constructed at great cost,—a double row of large long nets, supported in an upright position by means of corks fastened to their upper edge, and by lead weights and stones at the lower, are fixed by anchors in such a manner as to form an enclosure parallel to the shore for many hundred fathoms, sometimes an Italian mile in length, and divided into many chambers by transverse nets, and open on the land-side by a sort of door.

The flesh of the tunny, when uncooked, bears a close resemblance to beef. "You would scarcely believe," says Cetti, "the different tastes of the various parts of the tunny; at each part of the body, and at various depths from the surface, it varies; here it is like veal, there pork. The Sardinian fishermen employ a host of words, which the memory can scarcely retain, to distinguish these different morsels. The flesh of the belly, which is the most delicious, is called *sorra*, and costs twice as much as the *netta*, which is flesh of the second quality." Like all the mackerel tribes, the tunny remains fresh and good for a few hours only after it is taken; if the least tainted it is not only unwholesome, but even a dangerous kind of food.

[1] The *Cat-Fish*, or *Sea-Wolf*, (*Anarhichas lupus*.) This singular-looking fish is found in the more northern parts of the seas that surrounds the British islands; it is seldom met with on the southern coasts.

The appearance of this fish, (says Mr Yarrell,) is not prepossessing. Independently of a ferocious-looking, cat-like head, with an exceedingly thick coarse skin, covered with slime, it possesses most formidable teeth, and neither wants the will nor the power to attack others or defend itself. It is occasionally caught with a baited hook, at times decoyed into the meshes of a net by the temptation of the fishes already entangled; but fights desperately, even when out of its own element, inflicting severe wounds if not cautiously avoided. The nets also, are frequently torn by its powerful struggles, and a spirit of retaliation for the labour thereby occasioned, or for personal injury inflicted by it, brings a speedy death to the unfortunate fish. Handspikes and spars of wood are articles always at hand in fishing-boats, and the savage sea-cat is speedily rendered incapable of doing further harm by heavy well aimed blows upon the head.

As an article of food it is said to be excellent, although its appearance may disgust a squeamish stomach. The food of this fish consists chiefly of crabs, lobsters, and other crustaceous animals, to enable it to crush the hard covering of its prey, it is admirably furnished with teeth well adapted for the purpose; sharp in front to seize, and strong and rounded on each side of the jaw, on the roof of the mouth, and on the tongue itself, to crush. This fish sometimes attains the size of six or seven feet, and in the colder and more extreme northern seas is said to become still larger.

It swims rapidly, with a lateral undulating motion, and has acquired the name of sea-wolf from its voracity. It is called swine fish in the Orkneys, from a particular motion of the nose. It approaches the shore to deposit its spawn in the months of May and June, and the young, of a green colour, are usually found among sea-weed.

[2] The *Common Perch* was a great favourite with the Greeks and Romans as an article of food. In modern days, trout and salmon are preferred. The perch is extensively spread over the lakes and rivers of Europe in many varieties. In Great Britain, its general habitat is in lakes with a clear bottom and grassy margin, or in slow running streams. It is easily taken with various kinds of bait, the most successful of which, however, is the minnow. Its average size is from one pound to a pound and a half, though some of three and four pounds are by no means uncommon. In some of the Highland lochs, particularly those of Perthshire, perch are remarkably fine and abundant.

The *Basse* or *Sea Perch*, like the common perch, was much esteemed by the ancients. It is to be found on the coasts of England during the summer, while the Dutch have established fisheries of it. There are various species, among which may be mentioned the *Rock-fish* or *Striped Basse* of the Americans, which is abundant in the vicinity of New York, where it is brought to the markets weighing often sixty or seventy pounds.

The *Granulated Perch* (see Plate XXI. fig. 14.) inhabits the large rivers of America, and is so similar to that of Europe as to have been confounded with it.

The *Common Pike Perch* is to be found in the rivers and lakes of the north and east of Europe, but is unknown in Britain, France, and Italy. It attains a length of three or four feet, and a weight of twenty pounds. Large quantities of this fish, smoked and salted, are exported from Prussia and Silesia.

long; the fin covering the gills with three, six, or seven spines; prickles starting backward before the back fins and the fins of the anus.[1]

Prickly-finned Abdominal Fish.

24. The *Silurus* or *Sheath-fish.* The body oblong; the head large; the fin covering the gills from four to fourteen spines; the leading bones or spines in the back and pectoral fins toothed.

25. The *Mugul* or *Mullet.* The body oblong; the head almost conical; the upper-jaw with a furrow, which receives the prominence of the under; the fin covering the gills with seven rays.

26. The *Polynemus.* The body oblong; the head with a beak; the fin covering the gills with from five to seven spines; the bones that move the pectoral fins not articulated to those fins.

27. The *Teuthys.* The body almost elliptical; the head abruptly shortened; the fin covering the gills with five rays; the teeth in a single row, close, strong, and even.

28. The *Elops* or *Sea-serpent.* The body slender; the head large; the fin covering the gills double, with thirty spines, and armed externally with five bones resembling teeth.

SECT. II.

SOFT-FINNED FISHES.

Soft-finned Apodal Fish.

29. The *Muræna* or *Eel.* The body round and slender; the head terminating in a beak; the fin covering the gills with ten rays; the opening to the gills pipe-fashion, placed near the pectoral fins; the fins of the back, the anus, and the tail, united in one.[2]

30. The *Gymnotus* or *Carapo.*[3] The body roundest on the back, like the blade of a knife; the head small; the fin covering the gills with five rays; the back without a fin; two beards or filaments from the upper lip; an inhabitant of Brazil.

31. The *Anarhicas* or *Wolf-fish.* The body roundish and slender; the head large and blunt; the fore-teeth above and below conical; the grinding teeth and those in the palate round; the fin covering the gill has seven rays.

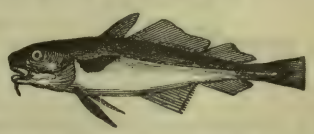
32. The *Stromateus.* The body oblong; the head small; the teeth moderately sharp; the fin covering the gills with five or six rays.

33. The *Ammodytes* or *Launce.* The body slender and roundish; the head terminated by a beak; the teeth of a hair-like fineness; the fin covering the gills with seven rays.

Soft-finned Jugular Fish.

34. The *Lepadogaster.* The body wedge-like; the head oblong, forwarder than the body, flattish, the beak resembling that of a duck; the pectoral fins double, two on each side; the ventral fins joined together; a kind of bony breastplate between the pectoral fins; the fin covering the gills with five rays; the opening to the gills pipe-fashion.

35. The *Gadus* or *Cod-fish.* The body oblong; the head wedge-like; the fin covering the



gills with seven rays: several back and anal fins.[4]

Soft-finned Thoracic Fish.

36. The *Pleuronectes* or *Flat-fish.* The body elliptical; the head small; both eyes on one side of the head; the fin covering the gills with from four to seven rays.

[1] The *fifteen-spined Stickleback* or *Great Stickleback.*—This fish, which is the largest species of the sticklebacks, is slender, being only an inch thick, and nine in length: the snout is long; and the body of a pentagonal figure towards the tail, which is flat, the mouth is small, and the upper jaw projects beyond the lower. The gills and the bony plate on the belly are brown upon the upper part, silvery and streaked upon the lower. It has two pectoral fins, one dorsal, rising in a triangular form from the middle of the back; between this and the head are fifteen distinct spines inclined towards the tail, which, when depressed, are insensible to the touch. The fins of the belly consist of two spines, the foremost of which is the longest. In the fin at the anus there is also a covered spine, but the other fins are soft and ramified. The fifteen-spined sticklebacks, like the last mentioned species, are found in the Baltic sea and the German ocean; they are very common in Holland, and also near Lubeck in the duchy of Holstein. M. Bloch says, that their ordinary size does not exceed seven inches, and that he has found small crabs in their stomach. The great stickleback does not ascend the rivers like the other kinds, never leaving the sea, where it is taken among other fish. Large quantities are sometimes taken by kindling a fire on the shore, which draws them in shoals to the nets. A kind of lamp oil is extracted from them and what remains is used as manure. They are, however, frequently eaten by the poor.

[2] See an account of Eels given in Note at page 286.

[3] See an account of the Gymnotus given in Note at page 279.

[4] The *Cod* is taken in immense numbers in all the northern coasts. It is abundant among the islands to the north and west of Scotland. It spawns about February, and is in the greatest perfection as food from the

37. The *Echineis* or *Sucking-fish.* The body almost wedge-like, moderately round; the head broader than the body; the fin covering the gills with ten rays; an oval breastplate, streaked in form of a ladder, toothed.

38. The *Lipidopus* or *Garter-fish.* The body sword-like, the head lengthened out;

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end of October to Christmas. There are two varieties of the Common Cod—the *Dogger Bank Cod*, with a sharp nose, and of a dark brown colour, and the *Scotch Cod*, with a blunt nose, and of a yellowish ash-green colour.

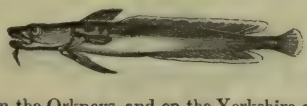
The *Haddock.*—This well-known fish is a species of the cod; it has a bearded mouth, and three fins on the back; the upper jaw longest, and the tail a little forked. On each side of the body, just beyond the gills, there is a dark spot, which the superstitious assert is the impression of St Peter's finger and thumb, when he took the tribute money (at the command of his Master) out of the mouth of a fish of this species, and which has ever since been continued to the whole race of haddocks.

Haddocks seldom grow to any great size; they very rarely become so large as to weigh twelve or fourteen pounds: they are esteemed more delicate eating when they do not exceed three pounds in weight. These fish, during stormy weather, are said to take shelter in the sand or mud, or among the sea-weeds. They feed on various small marine animals, and frequently become fat on herrings. The females deposit their spawn on the sea-weeds near the shore. The larger ones begin to be in roe in November, and continue so for somewhat more than two months: from this time till May they are reckoned out of season, and are not good. They then begin to recover. The small ones are extremely good from May till February; and those that are not old enough to breed, for even two months longer.

The *Whiting* is another species of the cod, but without a beard. Its flesh is more delicate than that of any other of the cod species.

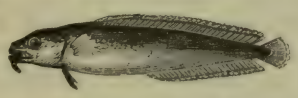


The *Ling.*—The Ling is a valuable species of cod. It is taken in large quantities among the Western



Islands, in the Orkneys, and on the Yorkshire and Cornwall coasts. In Yorkshire, the young are called *Drizzles*. The ling is very prolific, of voracious appetite, and tenacious of life. Its usual length is from three to four feet.

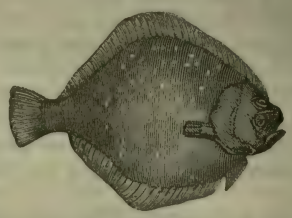
The *Torsk.* The Torsk or Tusk, another species of cod, is occasionally caught in the Forth, and brought to



the Edinburgh market. It is abundant in Orkney and Shetland. It is a somewhat tough fish, but excellently adapted for curing. Its usual length is from eighteen inches to two feet.

To the *Pleuronectes* or *Flat-fish* belong the Turbot, Sole, Flounder, Plaice, Dab, &c.

Turbots have sometimes been known to weigh from twenty-five to thirty pounds. Their general form is somewhat square. The upper parts of the body and fins are cinereous, with dark spots; and the under parts white: on the upper parts there are numerous short and blunt spines. The eyes are on the left side of the head. The northern parts of the English coast, and some



places off the coast of Holland, afford turbots in great abundance, and in greater excellency there than any other parts of the world. Lying here, however, in deep waters, they are seldom to be caught but by lines. In fishing for turbot off the Yorkshire coast, three men go out in each of the boats, each man provided with three lines, every one of which is furnished with two hundred and eighty hooks, baited and placed exactly six feet two inches asunder. These are coiled in an oblong piece of wicker-work, with the hooks baited and placed very regularly in the centre of the coil. When they are used, the nine are generally fastened together, so as to form one line with about two thousand hooks, and extending nearly three miles in length. This is always laid across the current. An anchor and a buoy are fixed at the end of each man's line. The tides run here so rapidly, that the fishermen can only shoot and haul their lines in the still water, at the turn of the tide; and therefore as it is flood and ebb about every alternate six hours, this is the longest time the lines can remain on the ground. When the lines are laid, two of the men usually wrap themselves in the sail and sleep, whilst the third is on watch to prevent their being run down by ships. The voracity of the turbot in pursuit of its prey is oftentimes such, that it carries them into the mouths of rivers, or the entrance of ponds in salt marshes, which communicate with the sea. But they are not contented with merely employing agility and strength in the procuring of their prey, they likewise have recourse to stratagem. They plunge themselves into the mud or sand at the bottom of the sea, and cover their whole body, except their eyes and mouth. Thus concealed, they seize upon, and devour all the smaller kinds of fish which incautiously approach them. It is said they are very particular in the choice of their food, refusing, invariably, all except living animals, or such as are not in the least degree putrid. And the fishermen assert, that they are never to be caught with baits which have been bitten by other fish. The holibut has been known to attain so great a weight as between two and three hundred pounds. Its general shape is long and narrow. The upper parts are dusky; and the under parts white. The skin is smooth, and destitute of spines. The eyes on the right side of the head.

The *Sole.*—This well-known and delicious fish is remarkable for one very extraordinary circumstance; among various other marine productions, they have been known to feed on shell fish, although they are furnished with no apparatus whatever in their mouth for reducing them to a state calculated for digestion. Some that were purchased by Mr Collinson, (as his letter inserted in the Philosophical Transactions states,) had their bellies hard and prominent, appeared to be filled with rows of some hard substance, which, on being opened, were found to be shell-fish. These, from the bulging of the

the fins covering the gills with seven rays; three scales only on the whole body; two in the place of the ventral fins; and the third from that of the anus.

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shells and the intervening interstices, give the intestines somewhat the appearance of strings of beads. On further examination, some of them were found nearly dissolved, others partly so, but many of them whole. The most usual food of soles is, the spawn and young of other fish. These fish are found on all of the British coasts; but those of the western shores are much superior in size to what are taken in the north, since they are sometimes found of the weight of six or seven pounds. The principal fishery for soles is in Torbay.

The *Flounder*, or *Fluke*, is one of the most common of the flat fish, and is abundant in our rivers and coasts. It feeds on aquatic insects, worms, and small insects. There are more varieties of the flounder than of any other species of flat-fish.

The *Bearded Flounder*.—The eyes of this fish are both on the same side of the head. The body is compressed, one side representing the back, and the other the abdomen. The whole body is scattered with gray spots; and it is bearded all round the fore part of the head. This fish is a native of the Indian and Red seas, measuring seven or eight inches in length. It seems to have been first considered a distinct species by Gronovius, but does not occur in the Systema Naturæ of Linnæus.

The *Plaice*.—Plaice are very flat, and much more square than the generality of flat-fish. Behind the left eye there is a row of six tubercles, that reaches to the commencement of the lateral line. The upper part of the body and fins are of a clear brown, marked with large bright orange-coloured spots; the belly is white. These fish are very common on most of our coasts, and sometimes taken of the weight of fifteen pounds, but they seldom reach that size, one of eight or nine pounds being reckoned a large fish. The best and largest are taken off Rye, on the coast of Sussex, and in Ireland; also off the Dutch coasts. They are watery eating; but are, notwithstanding, admired by some. They spawn in the beginning of February.

The *Dab*, or, as it is called in Edinburgh, the *Saltic* or *Salt-water Fluke*, is found with the preceding species, but is less common. It is generally of a uniform brown colour on the upper side, though sometimes clouded with a darker. The scales are small and rough, which is a character of this species. The lateral line is extremely incurvated in the beginning, then goes quite straight to the tail. The lower part of the body is white. This fish is in best season during February, March, and April, they spawn in May and June, and become flabby and watery the rest of the summer. They are superior in quality to the plaice and flounder, but rather inferior in size.

The *Lemon Dab*, *Smooth Dab*, or *Sand Fluke*, is not so common as the above. It is a prettier fish to look at,



having various shades of reddish brown and yellow. The flesh is equal to that of the common dab, and the substance of the body thicker.

The *Holibut* is one of the largest species of flat fish, but is chiefly confined to the Northern seas. Their flesh is dry and has little flavour, but oil is obtained from them.

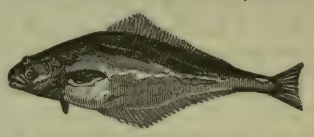
Soft-finned Abdominal Fish.

39. The *Loricaria*. The body crusted over; the head broad with a beak; no teeth; the fin covering the gills with six rays.

40. The *Atherina* or *Atherine*. The body oblong; the head of a middling size; the lips indented; the fin covering the gills with six rays; the line on the sides resembling a silver band.

41. The *Salmo* or *Salmon*.[1] (See Plate

In April, 1828, a holibut, taken near the Isle of Man, was exhibited at the Edinburgh market, measuring seven



feet six inches in length, three feet six inches in breadth, and weighing 320 lbs. It was the largest specimen ever seen there.

[1] The *Salmon*.—The Salmon, which was known to the Romans, but not to the Greeks, is a soft-finned abdominal fish. It is distinguished from other fish by having two dorsal fins, of which the hindermost is fleshy and without rays: it has teeth both in the jaws and in the tongue; and the body is covered with round and minutely striated scales. The colour of the back and sides is gray, sometimes spotted with black, and sometimes plain; the covers of the gills are subject to the same variety; and the belly is silvery. The nose is sharp-pointed: and in the males the under jaw sometimes turns up in the form of a hook. Rapid and stony rivers, where the water is free from mud, are the favourite places of most of the salmon tribe, the whole of which is supposed to afford wholesome food for mankind. This fish seems confined in a great measure to the northern seas, being unknown in the Mediterranean, and in the waters of other climates. It lives in fresh, as well as in salt waters, forcing itself in autumn up the rivers, sometimes for hundreds of miles, for the purpose of depositing its spawn. It abandons the seas where it finds an abundant sustenance, ascends the rivers depopulated by man, endeavours by every kind of artifice to escape the snares of the fishermen, and all this solely for the purpose of finding a convenient place for depositing its eggs. In these peregrinations it is that salmon are caught in the great numbers that supply our markets and tables. Intent only on the object of their journey, they spring up cataracts and other obstacles of a very great height. This extraordinary power seems to be owing to a sudden jerk that the fish gives to its body from a bent into a straight position. When they are unexpectedly obstructed in their progress, it is said they swim a few paces back, survey the object for some minutes, motionless, retreat, and return again to the charge; then, collecting all their force, with one astonishing spring leap over every obstacle. When the water is low, or sand-banks intervene, they throw themselves on one side, and in that position soon work themselves over into the deep water beyond. On the river Liffy, in Ireland, there is a cataract above nineteen feet high; here, in the salmon season, many of the inhabitants amuse themselves in observing the fish leap up the torrent. They frequently fall back many times before they surmount it; and baskets, made of twigs, are placed near the edge of the stream to catch them in their fall.

XXII. fig. 1.) The body oblong; the head a little sharp; the fin covering the gills from four to ten rays; the last fin on the back, without its corresponding muscles, fat.

42. The *Fistularia.* The body angular, in form of a spindle; the head pipe-fashion, with a beak; the fin covering the gills with seven rays; the under jaw covering the upper.

The *Parr*, or *Samlet*. This little fish, (says Mr Yarrell) one of the smallest of the British *salmonidæ*, has given rise to more discussion than any other species of the genus. Abounding in our salmon rivers, and



conspicuous for those lateral marks which are now known to be borne also for a time by the young of the trout as well as the fry of the other *salmonidæ*, and this fish always appearing of small comparative size, it has frequently been insisted upon as the young of the salmon, and local regulations have as generally been invoked for its preservation. The fry, however, of the different species of migratory *salmonidæ* are even now probably accurately known only to a few persons: their great similarity when very small has so frequently deceived even those who have lived the greater part of their lives on the salmon river banks, that the fry marked by them, in their experiments, believing them all to be what they considered the young of the parr, have been retaken as grilse, bull-trout, salmon-trout, and river-trout. That the parr is not the young of the salmon, or indeed of any other of the larger species of *salmonidæ*, as still considered by some, is sufficiently obvious from the circumstance that parrs by hundreds may be taken in the rivers all the summer, long after the fry of the year of the larger migratory species have gone down to the sea; and the greater part of those parrs taken even in autumn do not exceed five inches in length, when no example of the young of the salmon can be found under sixteen or eighteen inches, and the young of the bull-trout and salmon-trout are large in proportion. The transverse dusky bars from which this fish has obtained the name of brandling and fingerling are family marks, borne by all the species of the genus for a time, are obliterated by degrees, and at periods depending on the ultimate size attained by the individual species when adult; the soonest, probably in the salmon, and certainly the latest in the parr.

The *Trout*.—The general shape of the trout is rather long than broad: in several of the Scotch and Irish rivers, they grow so much thicker than those in England, that a fish from eighteen to twenty-two inches will often weigh from three to five pounds. This is a fish of prey; has a short roundish head, blunt nose, wide mouth filled with teeth, not only in the jaws, but in the palate and tongue; the scales are small; the back of an ash-colour; the sides yellow; and, when in season, is sprinkled all over the body and covers of the gills with small beautiful red and black spots; the tail is broad. The female has a smaller head and deeper body than the male, and is of superior flavour. In fact, the colour of the trout and its spots vary greatly in different waters, and at different seasons.

This fish, although very delicate, and at present well known, was in no esteem among the ancients. It abounded in most of the lakes of the Roman empire, yet is only mentioned by writers on account of its beautiful colours.

In some rivers trouts begin to spawn in October, but November is the chief month of spawning. About the end of September they quit the deep water to which they had retired during the hot weather, and make great efforts to gain the course of the currents, seeking out a proper place for spawning. This is always on a gravelly bottom, or where gravel and sand are mixed among stones towards the end and sides of the streams. At this period they turn black about the head and body, and become soft and unwholesome. They are never good when they are big with roe, which is contrary to the nature of most other fish. They multiply very fast, though they produce much less spawn than any other fish, which is probably owing to the voracious fish in these cold streams where they reside; and they would be still more numerous, if they were not so greedy as to devour each other. After spawning they become feeble, their bodies are wasted, and those beautiful spots, which before adorned them, are imperceptible; their heads appear swelled, and their eyes are dull. In this state they seek still waters, and continue there sick, as is supposed, all the winter. There are in all trout rivers some barren female fish, which continue good throughout the winter.

These fish begin to leave their winter quarters in March, or sometimes earlier, if the weather be mild, and approach the shallows and tails of streams, where they cleanse and restore themselves. As they acquire strength they advance still higher up the rivers, till they fix on their summer residence; for which they generally choose an eddy behind a stone, a log, or bank, that projects into the water, and against which the current drives.

The varieties of the common trout are almost infinite; from the great lake trout, which weighs above sixty or seventy lbs. to the trouts of the little mountain brook, which is scarcely larger than the finger. The gilleroo trout and par, samlet or brandling may be considered as forming distinct species.

The *Great Gray Trout of Lochawe*.—According to Sir William Jardine, this fish, as far as can be traced,



seems to have been first noticed about forty-five years since by the late Mr Morison of Glasgow, who used to exhibit them to his friends as the trophies of his expeditions. The first specimens taken in Loch Awe by Mr Selby and Sir William Jardine were considered as a species undescribed and new to Britain; and the name of *Salmo ferox* was given to it, from its extreme voracity and rapacious habits. M. Agassiz, who saw specimens of this fish when he was in Edinburgh, pronounced it to be different from any of the large continental species.

In Scotland this fish appears to be generally distributed in all the larger and deeper lochs. Loch Awe, Loch Laggan, the upper end of Loch Shin, Lochs Loyal and Assynt, they certainly inhabit, roving indiscriminately, and feeding almost entirely upon the smaller fish. By persons residing on the banks they are taken by night-lines, few rising at the artificial fly; but they may always be taken by strong trolling tackle, baited with a small trout. They are extremely voracious, and having seized the bait, they will allow themselves to be dragged by the teeth for forty or fifty yards; and when accidentally freed, will immediately again seize it.

This great trout is almost entirely confined to the lochs, seldom venturing far either up or down any of the streams communicating with them, and never descending to the sea. It is known to spawn in September.

43. The *Esox* or *Pike*.[1] The body round; the head with a beak; the under jaw pierced longitudinally with small holes; the fin covering the gills with from seven to twelve rays.

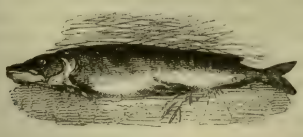
The most usual mode of fishing for this great lake trout is from a boat, which is rowed gently through the water; the bait, as before mentioned, a small trout, guarded by six or eight large hooks; the rod and line of great strength; for this fish is considered to be even stronger than a salmon of the same size, but not so active. Young fish from one to two pounds' weight rise freely to the usual trout flies.

The *Salmon-trout*, so called from its resemblance to the two fish whose name it bears, attains the size of a small salmon; is spotted in the same manner as the trout; and, like it, spawns in winter. Like the salmon it sometimes inhabits the sea, and sometimes the rivers; it likewise ascends into the latter to deposit its spawn. The salmon-trouts, however, do not quit the sea so early as the salmon, being seldom seen in the rivers before the month of May. They spawn in the same manner as salmon, in November or December; but as the rivers are then frozen, they do not retire to the sea till after the thaw. Like all other fish of the same genus, they live upon aquatic insects, worms, and small fish, and are fond of rapid streams, with a bottom of sand and gravel. Their flesh is red, and well-tasted, particularly before the spawning season. Its quality depends, in a great measure, on the greater or less degree of purity of the streams in which the fish are taken; their colour and spots vary extremely from the same cause. They die soon after they are taken out of the water. Young salmon trout are known by the name of whitlings; and many have supposed them to be young salmon, which opinion has been proved to be ill-founded.

Salmon-trouts attain a considerable size, weighing sometimes eight or ten pounds. Dr Bloch describes one that was twenty inches in length, an inch and a half thick, and which weighed five pounds and three quarters. This gentleman discovered, that this fish, like several kinds of sea-fish, possesses the quality of emitting light in a dark place; and that the palate, tongue, gills, and eyes, were endowed with that property in an eminent degree. When touched with the finger, those parts cast a considerable light; and when any other part was rubbed with the same finger, that quality was likewise communicated to it. The luminous matter, the doctor imagines, is contained in the slimy substance which covers those parts; for the flesh does not afford the smallest appearance of light. He kept fish eight days, and this luminous property diminished in proportion as the viscous matter was dried up.

The *Grayling* is a scarce fish in England, and is not to be found in Scotland or Ireland. They frequent rivers of peculiar temperature or current.

[1] The *Pike*, from its fierce disposition and great voracity, has been called, not unaptly, the *fresh-water shark*; it is found in almost all of the fresh waters of Europe, and in those of the north of Asia and of America, being everywhere noted for the great rapidity of its growth.



The head of the pike is large, flattened in front, and compressed on the sides. The opening of the mouth is extremely deep, and extends as far back as the eyes; the lower jaw is somewhat longer than the upper; the front teeth on this jaw are strong but small, and every other one is moveable. The upper jaw is furnished with teeth in front only, but the palate also possesses three rows of teeth, the two outer rows of which are very strong and turned backwards. As many as seven hundred teeth have been counted in the jaws of a pike, without including those which are found in the throat, and near the internal opening to the gills. The mouth of this tyrant is, indeed, every way formidable, for even the tongue itself is covered with teeth.

This fish, in the course of the first year's growth, attains the length of eight or ten inches, in the second, twelve or fourteen, and in the third, eighteen or twenty. It has been found as much as eight feet in length, and in the great fresh-water lakes of the north of Europe, and the rivers of Northern Asia, as for instance the Volga, specimens four or five feet in length are far from rare.

Among the extraordinary tales recorded of this fish, the following is one of the most remarkable, and, at the same time, among the best authenticated. In 1497 a pike was taken at Kayserslautern, in the palatinate of the Rhine, which weighed three hundred and fifty pounds; a painting was made of this wonderful fish, which is preserved in the castle of Lautern, and the skeleton was preserved at Manheim. The emperor Barbarossa had placed this fish in the lake in the year 1230, with a ring of gilded copper attached to it, so constructed as to be capable of expanding with the growth of the fish. So that when taken, a period of two hundred and sixty-seven years had elapsed from the period when it had been reconsigned to the lake encumbered with this singular memento.

As already observed, the pike is common in all the rivers, lakes, and ditches, of the north of Europe, but it is much less seldom met with towards the south. It is said to have been introduced into England in the reign of Henry VIII. when it was so rare that a pike sold at double the price of a house lamb in February, and a pickerel (small pike,) for more than a fat capon.

The instances of the voracity of this fish are numerous; for, not content with small fish and frogs, it will devour rats, young ducks, and occasionally much more formidable prey. In the *History of Staffordshire* it is stated that, "at Lord Gower's estate at Trentham, a pike seized the head of a swan, as she was feeding under water, and gorged so much of it as killed them both. The servants, perceiving the swan remain in the same position for a considerable time, went in a boat, and found both swan and pike dead.

Gesner says, that a famished pike, in the Rhone, fixed on the lips of a mule that was drinking, and was drawn out by the beast before it could disengage itself.

In December, 1765, a pike was caught in the river Ouse, weighing upwards of twenty-eight pounds, and was bought by a gentleman in the neighbourhood for a guinea. When opened, the cook found a watch with two seals attached to it by a black riband, in the body of the fish. These, it was afterwards discovered, had belonged to a gentleman's servant, who had been drowned about six weeks before.

Pikes are necessarily great destroyers of fish in ponds, but there are two descriptions of fishes, namely, the perch and the stickleback, which they are unwilling to attack; the sharp spines of their back-fins sticking in the throat of the pike, more particularly that of the stickleback.

An instance lately occurred at Edmonton of a pike capturing a sparrow, that was perched on the edge of a water-lily in a pond. The fish surprised the unsuspect-

44. The *Argentina* or *Argentine*. The body a little round and slender; the head with a beak, broader than the body; the fin covering the gills with eight rays; a spurious back-fin.

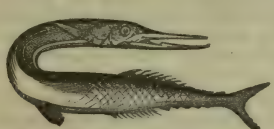
45. The *Clupea* or *Herring*.[1] The body a little oblong; the head with a small beak; the fin covering the gills with eight rays.

ing bird, by springing out of the water and seizing it by a sudden snap.

A singular encounter, which took place at Waldstein, between a pike and a fox, is commemorated in a German print. Some country-people had taken a large pike, but in conveying it home during the night, it escaped. As it was a large fish, they returned with torches in search of their prize, and after some time found it on the grass, having fast hold of a fox by the nose. The fox, caught in this novel trap, endeavoured in vain to escape, and it was not until the pike was killed, that it was possible to separate them.

Pikes are in the habit of basking in the sun, when they float upon the surface of the water; at this time they are sometimes shot, or taken by a noose of wire, fixed to a strong pole about four yards long, by which the wire, with great slowness, is conducted over the pike's head, gills, and fins, and then hoisted with a jerk to land.

The *Saury Pike* or *Skipper*, was first described as a British species by Ray: those he saw were taken on



the Cornish coast. The Rev. Mr Low, in his Natural History of Orkney, says, that the year preceding that in which he wrote his *Fauna Orcadensis*, such a glut of these fish set into the head of Kerston bay, that they could be taken by pailfuls: numbers were caught, and heaps flung ashore. According to Mr Neill, the saury is not at all an uncommon fish in the Frith of Forth, numbers running up with the flood-tide in the autumn; but they do not, like other fishes, retire from the shallows at the ebbing of the tide, but are then found by hundreds, having their long noses stuck in the sludge, and are picked up by people from Kincardine, Alloa, and other places. Mr Pennant mentions that great numbers of sauries were thrown ashore at Leith, by a storm, in November 1768. The saury has been taken at Yarmouth on the east, and off Portland Island on the south; being, on some occasions, even plentiful in Cornwall. Mr Couch says—

"The skipper is more strictly than the gar-pike a migratory fish, never being seen in the channel until the month of June, and it commonly departs before the end of autumn. It does not swim deep in the water; and in its harmless manners resembles the flying fish, as well as in the persecution it experiences from the ravenous inhabitants of the ocean, and the method it adopts to escape from their pursuit. It is gregarious, and is sometimes seen to rise to the surface in large shoals, and flit over a considerable space. But the most interesting spectacle, and that which best displays their great agility, is when they are followed by a company of porpoises, or their still more active and persevering enemies the tunny and bonito. Multitudes then mount to the surface, and crowd on each other as they press forward. When still more closely pursued, they singly spring to the height of several feet, leap over each other in singular confusion, and again sink beneath. Still further urged, they mount again, and rush along the surface by repeated starts for more than a hundred feet, without

[1] See an account of the Herring in a succeeding page.

46. The *Exocetus* or *Flying-fish*.[2] The body oblong; the head almost three-cornered; the fin covering the gills with seven rays; the pectoral fins placed high, and as long as the

once dipping beneath, or scarcely seeming to touch the water. At last, the pursuer springs after them, usually across their course; and again they all disappear together. Amid such multitudes—for more than twenty thousand have been judged to be out of the water together—some must fall a prey to the enemy; but as many hunt in company, it may be long before the pursuit is abandoned. From inspection, we should scarcely judge the fish to be capable of such considerable flights; for the fins, though numerous, are small, and the pectorals far from large—though the angle of their articulation is well fitted to raise the fish by the direction of their motions to the surface; the force of its spring must therefore be chiefly ascribed to the tail and finlets. It rarely takes a bait; and when this has happened, the boat has been under sail, the men fishing with a lask, or slice of mackerel made to imitate a living bait. The skipper has not been commonly taken since the drift fishermen began the practice of sinking their nets a fathom or two beneath the surface—a circumstance which marks the depth to which they swim; but before this, it was usual to take them, sometimes to the amount of a few hundreds, at almost every shoot of the pilchard nets."—*Yarrell's British Fishes.*

[2] The *Flying Fish*.—"No familiarity," says Captain Basil Hall, "with the sight, can ever render us indifferent to the graceful flight of these most interesting of all the finny, or, rather, winged tribe. On the contrary, like a bright day, or a smiling countenance, the more we see of them, the more we value their presence. I have, indeed, hardly ever observed a person so dull, that his eye did not glisten as he watched a shoal, or, it may be called, a covey of flying-fish, rise from the sea, and skim along for several hundred yards. There is something in it so peculiar, so totally different from every thing else in other parts of the world, that our wonder goes on increasing every time we see one take its flight; so that we may easily excuse the old Scottish wife, who said to her son, when he was relating what he had seen abroad; "You may hae seen rivers o' milk, and mountains o' sugar, but you'll ne'er gar (make) me believe you hae seen a fish that could flee!'

"I have endeavoured to form an estimate as to the length of these flights, and find two hundred yards, or about an eighth of a mile, set down in my notes as about the longest distance, which they perform in somewhat more than half a minute. These flights, however, vary from that length to a mere skip out of the water. Generally speaking, they fly to a considerable distance in a straight line, in the wind's eye, that is, exactly towards the point from which the wind blows, and then gradually turn off to leeward. But sometimes they merely skim the surface, so as to touch only the tops of the waves. A notion prevails afloat, but I know not how just it may be, that they can fly no longer than whilst their wings, or fins, remain wet. That they rise as high as twenty feet above the water is certain, from their being found in parts of a ship, which are full as much as that out of the sea. I remember seeing one about nine inches in length, and weighing not less, I should suppose, than half a pound, skim into the *Volage's* main-deck port just abreast of the gang-way. One of the seamen was coming up the quarter-deck ladder at the moment, when the fish, entering the port, struck the astonished mariner on the temple, knocked him off the step, and very nearly threw him down at full length.

"The amiable Humboldt good-naturedly suggests that the flights of these fish may be mere gambols, and not proofs of their being pursued by their enemy, the

whole body; the back-fin at the extremity of the back.

47. *Cyprinus* or *Carp.* The body elongated, almost round; the head with a small beak; the hinder part of the bone covering the gills, marked with a crescent; the fin covering the gills with three rays.[1]

48. The *Cobitis* or *Loach.* The body ob-

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dolphin. I wish I could believe so; for it were much more agreeable to suppose, that at the end of the fine sweep which they take, they fall safely on the bosom of the sea.

"I do not recollect whether that eminent traveller, who not only observes many more things than most men, but describes them much better, has any where mentioned his having witnessed one of these chases. The best I remember, was during the first voyage I ever made, through those regions of the sun, the tropical seas, and I will therefore describe it.

"We were stealing along pleasantly enough, under the influence of a newly-formed breeze, which, as yet, was confined to the upper sails, and every one was looking open-mouthed to the eastward, to catch a little cool air, or was congratulating his neighbour on getting rid of the calm in which we had been so long half-roasted, half-suffocated, when about a dozen flying fish rose out of the water, and skimmed away to windward, at the height of ten or twelve feet above the surface. Shortly after, discovered two or three dolphins, ranging past the ship in all their beauty. Presently, the ship in her course, put up another shoal of those little creatures, which flew in the same direction which the others had taken.

"A large dolphin, which had been keeping company with us at the depth of two or three fathoms, and as usual, glistening most beautifully in the sun, no sooner detected our poor dear little friends taking wing, than he turned his head towards them, and darting to the surface, leaped from the water with a swiftness little short, as it seemed, of a cannon-ball. But, although the force with which he shot himself into the air, made him gain upon the flying-fish at first, yet the start which they had got, enabled them to keep ahead of him for a considerable time.

"The length of the dolphin's first spring, could not be less than ten yards; and after he fell, we could see him gliding like lightning through the water, for a moment, when he again rose and shot forward with a speed considerably greater than at first, and of course, to a still greater distance. In this manner, the merciless pursuer seemed to stride along the sea with fearful rapidity, whilst his brilliant coat sparkled and flashed in the sun quite splendidly. As he fell headlong on the water, at the end of each huge leap, a series of circles were sent far over the still surface, which lay as smooth as a mirror.

"The group of flying-fish thus hotly pursued, at length dropped into the sea; but we were rejoiced to observe, that they merely touched the top of the swell, and scarcely sunk into it: at least, they instantly set off again in a fresh, and even more vigorous flight. It was particularly interesting to observe, that the direction they now took was quite different from the one in which they had set out; thus implying, that they had detected their fierce enemy, who was following them, with giant steps, along the waves, and was now rapidly gaining upon them. His terrific pace, indeed, was two or three times as swift as theirs,—poor little things!

"The dolphin was fully as quick-sighted as the flying-fish. For whenever they changed their flight in the smallest degree, he lost not the tenth part of a second in shaping a new course in pursuit, whilst they in a manner really not unlike that of the hare, doubled more than once upon their pursuer. But it was soon too plainly to be seen, that the strength and confidence of the flying-fish was fast ebbing. Their flights became shorter and shorter, and their course more fluttering and uncertain, whilst the enormous leaps of the dolphin appeared to grow only more vigorous at each bound. At last, indeed, we could see, or fancied we could see, that this skilful sea-sportsman so arranged all his springs, that he contrived to fall at the end of each, just under the very spot, on which the exhausted flying-fish were about to drop! Sometimes this took place at too great a distance for us to see from the deck exactly what happened; but on our mounting high into the rigging, we could discover that many of the unfortunate little creatures, one after another, either fell right into the dolphin's jaws, as they lighted on the water, or were snapped up instantly afterwards."

[1] The *Common Carp.*—In their general habits these fish exhibit so great a degree of cunning, as to be sometimes called by the country people the River Fox. When attempted to be taken by a net, they will often leap over it; or immerse themselves so deep in the mud, as to suffer the net to pass over without touching them. They are also very shy of taking a bait; but, during spawning-time, so intent are they on the business of depositing their ova, that they will suffer themselves to be handled by any one who attempts it. They breed three or four times in the year, but their first spawning is in the beginning of May. Carp are found in the slow rivers and stagnant waters of Europe and Persia; and here principally in deep holes, under the roots of trees, hollow banks, or great beds of flags, &c. They do not often exceed four feet in length, and twenty pounds in weight; but Jovius mentions some caught in the Lago de Como, in Italy, that weighed two hundred pounds each, and others have been taken in the Dneister five feet in length.

The carp is the least carnivorous among fishes. It is very tenacious of life, and can be carried alive over land for great distances. It has been frequently carried alive from Strasburgh to Paris, by keeping a little wet moss in contact with the gill-lids; and without even this simple precaution it will live for a long time out of water. "And, doubtless," says Izaac Walton, "as of sea-fish, the herring dies soonest out of the water, and of fresh-water fish, the trout, so, except the eel, the carp endures most hardness, and lives longest out of his own proper element. And, therefore, the report of the carp's being brought out of a foreign country into this nation, is the more probable." One of the recent editors of Walton says that it is a common practice in Holland to keep carp alive for three weeks or a month, by hanging them in a cool place, with wet moss in the mouth, and feeding them with bread and milk.

The carp does not delight in troubled waters: it loves to haunt placid streams which steal along without any perceptible current; such as the moats and trenches of old castles; or retired shady ponds, where aquatic plants accumulate. It feeds upon these vegetables, and, from the quietness of its habits, it attains a great age. When very old its back becomes quite white. Gesner says, that a carp has been known to live in the palatine above a hundred years. In 1782, a gentleman of Emanuel college, Cambridge, published an account of a carp which had inhabited a small artificial pond in the college for thirty-six years; and that, although the fish had lost one eye, yet it knew, and would constantly swim up to its feeder. Carps are not timid, but rather fond of society; and, as in the instance just given, they are so far capable of being educated, as to come and be fed at stated hours on being whistled to. There are immense numbers of this fish in the stilly part of the Rhine, near Strasburgh; and vast quantities are sent annually to Paris.

The food of the carp is animal, as well as vegetable.

long; almost equally broad throughout; the head small, a little elongated; the eyes in the hinder part of the head; the fin covering the gills from four to six rays: the covers of the gills closed below.

49. The *Amia* or *Bonito*. The body round and slender; the head, forehead, and breast, without skin; the fin covering the gills with twelve rays; two beards from the nose.

50. The *Mormyrus*. The body oblong; the

It eats worms and aquatic insects, and is also said to swallow the mud at the bottom of its abode for the sake of larvæ and seeds. Hence the flavour of its flesh depends upon the nature of its food. Walton says, in his usual quaint and amusing style, "the tongues of carps are noted to be choice and costly meat, especially to them that buy them; but Gesner says, carps have no tongue like other fish, but a piece of flesh like fish, in their mouth, like to a tongue, and should be called a palate; but it is certain it is choicely good, and that the carp is to be reckoned among those leather-mouthed fish, which, I told you, have their teeth in their throat; and for that reason he is very seldom lost by breaking his hold, if your hook be once stuck in his chops."

The general length of the carp is about two feet: specimens have, however, been found of four feet in length.

The frog is said to be the mortal enemy of the carp. Walton says, that a pond, well stocked with carp has been known to lose all its fish in a single summer, in consequence of the depredations of the frogs. He says that a "gentleman of tried honesty" told him that he saw, in a hot day in summer, a large carp swim near the top of the water, with a frog upon its head; and that he upon that occasion caused his pond to be let dry; and I say, of seventy or eighty carps, he only found five or six in the said pond, and those very sick and lean; and with every one a frog, sticking so fast on the head of the said carps, that the frog could not be got off without extreme force or killing. And a person of honour, now living in Worcesteshire, assured me he had seen a necklace, or collar of tadpoles, hang, like a chain, or necklace of beads, about a pike's neck, and so killed him; whether it were for meat or malice, must be to me a question.

Gold and Silver Carp, or what are called *Gold and Silver Fishes*,—the *Cyprinus Auratus*, of Linnæus—were brought originally to England from China about the year 1691.

The former are of an orange gold colour, with very shining scales, and finely variegated with black and dark brown. When young, its colour is dark brown or black, which is afterwards replaced by the orange gold hue. It is naturalized in this country, and in other parts of Europe, and breeds freely in warm and sheltered situations. Our supply is chiefly obtained from Portugal, where this fish abounds. The silver fish differs from the former only in colour, which is similar to silver tissue; it generally has scarlet fins, and is curiously marked in several parts of the body. Both varieties are also subject to variation in the fins, which are occasionally double; and specimens have been seen with triple tails, but such a developement is generally at the expense of some other fin.

When I happen to visit a family (says Gilbert White) where gold and silver fishes are kept in a glass bowl, I am always pleased with the occurrence, because it offers me an opportunity of observing the actions and propensities of those beings with whom we can be little acquainted in their natural state. Not long since I spent a fortnight at the house of a friend, where there was such a *vivary*, to which I paid no small attention, taking every occasion to remark what passed within its narrow limits. It was here that I first observed the manner in which fishes die. As soon as the creature sickens, the head sinks lower and lower, and it stands as it were on its head; till, getting weaker, and losing all poise, the tail turns over, and at last it floats on the surface of the water, with its belly uppermost. The reason why fishes, when dead, swim in that manner is very obvious; because when the body is no longer balanced by the fins of the belly, the broad muscular back preponderates by its own gravity, and turns the belly uppermost, as lighter, from its being a cavity, and because it contains the swimming bladders, which contribute to render it buoyant.

Some that delight in gold and silver fishes have adopted a notion that they need no aliment. True it is, that they will subsist for a long time without any apparent food, but what they can collect from pure water, frequently changed; yet they must draw some support from animalculæ, and other nourishment supplied by the water; because, though they seem to eat nothing, yet indications of their having eaten are found in their glass abodes. That they are best pleased with such *jejune* diet may easily be confuted; since, if you toss them crumbs they will seize them with great readiness, not to say greediness: however, bread should be given sparingly, lest, turning sour, it corrupt the water. They will also feed on the aquatic plant called *lemna*, or duck's meat, and also on small fry.

Hawkins, the editor of Walton, says that fine gravel should be strewed at the bottom of the vessel containing the fish; "frequently changing the water, and feeding them with bread and gentles. Those who can take more pleasure in angling for, then in beholding them, which I confess I could never do, may catch them with gentles; but though costly, they are but coarse food."

When they want to move a little (continues White) they gently protrude themselves with their *pinnæ pectorales;* but it is with their strong muscular tails only that they, and all fishes, shoot along with such inconceivable rapidity. It has been said that the eyes of fishes, are immovable: but these apparently turn them forward or backward in their sockets, as their occasions require. They take little notice of a lighted candle, though applied close to their heads, but flounce and seem much frightened by a sudden stroke of the hand against the support whereon the bowl is hung, especially when they have been motionless, and are perhaps asleep. As fishes have no eyelids, it is not easy to discern when they are sleeping or not, because their eyes are always open. Nothing can be more amusing than a glass bowl, containing such fishes: the double refractions of the glass and water represent them when moving in a shifting and changeable variety of dimensions, shades, and colours; while the two mediums, assisted by the concavo-convex shape of the vessel, magnify and distort them vastly; not to mention that the introduction of another element and its inhabitants into our parlours engages the fancy in a very agreeable manner. Some people exhibit this sort of fish in a very fanciful way; for they cause a glass bowl to be blown with a large hollow space within, that does not communicate with it. In this cavity they put a bird occasionally, so that you may see a goldfinch or a linnet, hopping as it were in the midst of the water, and the fishes swimming in a circle round it. The simple exhibition of the fishes is agreeable and pleasant; but in so complicated a way, becomes whimsical and unnatural, and liable to the objection due to him,

Qui variare cupit rem prodigaliter unam. *

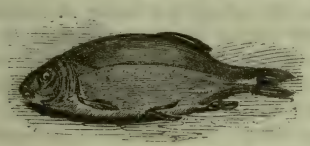
The *Tench*.—This, according to Artedi, is a species of the carp, and is thick and bulky in proportion to its

* "Who desires to impart a monstrous variation to an object."

head elongated; the fin covering the gills with a single ray, the opening to the gills is linear, and has no bone covering them.

Such is the system of Mr Gouan; by reducing to which any fish that offers, we can know its rank, its affinities, and partly its anatomy, all which make a considerable part in its natural history. But to show the use of this system still more apparently, suppose I meet with a fish, the name to me unknown, of which I desire to know something more. The way is first to see whether it be a cartilaginous fish, which may be known by its wanting fins to open and shut the gills, which the cartilaginous kinds are wholly without. If I find that it has them, then it is a spinous fish; and in order to know its kind, I examine its fins whether they be prickly or soft; I find them soft; it is therefore to be ranked among the soft-finned fishes. I then examine its ventral or belly fins, and finding that the fish has them, I look for their situation, and find they lie nearer to the tail than the pectoral fins. By this I find the animal to be a soft-finned abdominal fish. Then, to know which of the kinds of these fishes it is, I examine its figure and the shape of its head: I find the body rather oblong; the head with a small beak; the lower jaw like a saw; the fin covering the gills with eight rays. This animal must, therefore, be the herring, or one of that family, such as the pilchard, the sprat, the shad, or the anchovy. To give another instance: upon examining the fins of a fish to me unknown, I find them prickly; I then look for the situation of the ventral fins; I find them entirely want-

length. The colour of the back is dusky; the dorsal and ventral fins of the same colour; the head, sides, and



belly, are of a greenish cast, most beautifully mixed with gold, which is in its greatest splendour when the fish is in highest season. They love still waters, and are rarely found in rivers; they are very foolish, and easily caught. This is one of those fish that prefer foul and weedy waters; and its haunts in rivers are chiefly amongst weeds, and in places well shaded with rushes. These fish thrive best in standing waters, where they lie under weeds near sluices and pond-heads. They are much more numerous in pools and pits than in rivers; but those taken in the latter are far preferable for the table. They begin to spawn in June, and may be found spawning in some waters till September. The best season is from that time till the end of May. These fish do not often exceed four or five pounds in weight. Mr Pennant, however, mentions one that weighed ten pounds. Tench are in great repute with us as delicious and wholesome food; but in Guernsey they are considered bad fish, and in contempt called shoemaker. Gesner even says, that it is insipid and unwholesome. Like the barbel, it was unnoticed by early writers; and Ausonius, by whom it was first mentioned, treats it with that disrespect which evinces the capriciousness of taste. These fish are sometimes found in waters where the mud is excessively fetid, and the weeds so thick that a hand-net can hardly be thrust down. In these situations they grow to a large size, and their exterior becomes completely tinged by the mud. Their flavour from this, if cooked immediately on being taken out, is often very unpleasant; but if they are transferred into clear water, they soon recover from the obnoxious taint. A tench was taken at Thornville-Royal in Yorkshire, in 1802, of such enormous size, and so singular in its shape, as rather to be accounted a *lusus naturæ* than a regular product. A piece of water which had been ordered to be filled up, and into which wood and rubbish had been thrown for some years, was directed to be cleared out. So little water remained, and in such quantity were the weeds and mud, that it was expected no fish would be found, except perhaps a few eels; but, greatly to the surprise of the persons employed, nearly two hundred brace of tench, and as many perch, were discovered. After the pond was supposed to be quite cleared, an animal was observed to be under some roots, which was conjectured to be an otter. The place was surrounded; and on making an opening, a tench was found of a most singular form, having literally taken the shape of the hole in which he had of course been many years confined. His length was four feet nine inches, his circumference two feet three inches, and his weight near twelve pounds. The colour was also singular, his belly being tinged with vermilion like that of a char. This extraordinary animal, after having been examined by many gentlemen, was carefully put into a pond. At first it merely floated, and after a while it swam gently away. When Mr Daniel produced his "Rural Sports" it was alive and well.

The *Chub*.—This fish, which is called cheven, nab, or, botling, very much resembles the carp, but is of a



longer form. The body is oblong, rather round, and is of an equal thickness in the greater part of the slope; the scales are large; the irides silvery; the cheeks of the same colour; the head and back of a deep dusky green; the sides silvery, but in the summer yellow; the belly white; the pectoral fins of a pale yellow; the ventral and anal fins red; and the tail forked, of a brownish hue, but tinged with blue at the end. It is altogether a handsome fish, but in no esteem for the table, being very coarse, and when out of season full of small hairy bones: the roe however is very good; and this fish stewed as carp will, it is said, deceive a connoisseur. Its name is derived from the shape of the head, cop being an old English word for head; and the French and Italians know it by a name synonymous with ours. The haunts of these fish are rivers whose bottoms are of sand or clay, or which are bounded by clayey banks, in deep holes, under hollow banks, shaded by trees or weeds. They are also found in the Esk, a river noted for the crystalline clearness of its waters, flowing over a rocky bottom. These fish often float on the surface, and are sometimes found in deep waters, where the currents are strong. In ponds fed by a rivulet they grow to a large size. They seldom, however, exceed the weight of four or five pounds, though Salvanus speaks of them as increasing to eight or nine. They deposit their spawn in April; and are in great perfection during the months of December and January.

ing ; this then must be a prickly-finned apodal fish. Of this kind there are but three : and by comparing the fish with the description, I find it either of the trichurus kind, the sword-fish, or the gilt-head. Upon examining also its internal structure, I shall find a very great similitude between my fish and that placed at the head of the family.

CHAP. II.

OF SPINOUS FISHES IN GENERAL.

Having given a method by which Spinous Fishes may be distinguished from each other, the history of each in particular might naturally be expected to follow ; but such a distinct account of each would be very disgusting, from the unavoidable uniformity of every description. The history of any one of this class very much resembles that of all the rest : they breathe air and water through the gills; they live by rapine, each devouring such animals as its mouth is incapable of admitting; and they propagate, not by bringing forth their young alive, as in the cetaceous tribes, nor by distinct eggs, as in the generality of the cartilaginous tribes, but by spawn, or peas, as they are generally called, which they produce by hundreds of thousands. These are the leading marks that run through their whole history, and which have so much swelled books with tiresome repetition.

It will be sufficient therefore to draw this numerous class into one point of view, and to mark how they differ from the former classes ; and what they possess peculiarly striking, so as to distinguish them from each other. The first object that presents itself, and that by which they differ from all others, are the bones. These, when examined but slightly, appear to be entirely solid; yet when viewed more closely, every bone will be found hollow, and filled with a substance less rancid and oily than marrow. These bones are very numerous, and pointed ; and, as in quadrupeds, are the props or stays to which the muscles are fixed which move the different parts of the body.

The number of bones in all spinous fishes of the same kind, is always the same. It is a vulgar way of speaking to say, that fishes are at some seasons more bony than at others; but this scarcely requires contradiction. It is true indeed, that fish are at some seasons much fatter than at others : so that the quantity of the flesh being diminished, and that of the bones remaining the same, they appear to increase in number, as they actually bear a greater proportion.

All fish of the same kind, as was said, have the same number of bones: the skeleton of a fish, however irregularly the bones may fall in our way at table, has its members very regularly disposed ; and every bone has its fixed place, with as much precision as we find in the orders of a regular fabric. But then spinous fish differ in the number of bones according to the species: for some have a greater number of fins by which they move in the water. The number in each is always in proportion to the number and size of these fins : for every fish has a regular apparatus of bones and muscles by which the fins are moved ; and all those fish, where they are numerous or large, must, of consequence, be considerably bony. Indeed, in the larger fish, the quantity of flesh is so much, and the bones themselves are so large, that they are easily seen and separated ; but in the smaller kinds with many fins, the bones are as numerous as in the great; yet being so very minute, they lurk almost in every part of the flesh, and are dangerous as well as troublesome to be eaten. In a word, those fish which are large, fat, and have few fins, are found to be the least bony; those which are small, lean, and have many fins, are the most bony of all others. Thus, for instance, a roach appears more bony than a carp, because it is leaner and smaller; and it is actually more bony than an eel, because it has a greater number of fins.

As the spinous fish partake less of the quadruped in their formation than any others, so they can bear to live out of their own element a shorter time. In general, when taken out of the water they testify their change by panting more violently and at closer intervals, the thin air not furnishing their gills the proper play; and in a few minutes they expire. Some indeed are more vivacious in air than others; the eel will live several hours out of water; and the carp has been known to be fattened in a damp cellar. The method is by placing it in a net well wrapped up in wet moss, the mouth only out, and then hung up in a vault. The fish is fed with white bread and milk; and the net now and then plunged into the water. The animal, thus managed, has been known not only to live for a fortnight, but to grow exceedingly fat, and of a superior flavour. From this it would seem that the want of a moisture in the gills is the chief cause of the death of these animals; and could that be supplied, their lives might be prolonged in the air, almost as well as in their own element.

Yet it is impossible to account for the different operations of the same element, upon animals that, to appearance, have the same conformation. To some fishes, bred in the sea, fresh

water is immediate destruction: on the other hand, some fishes, that live in our lakes and ponds, cannot bear the salt water. Whence this difference can arise, is not easily to be accounted for. The saline quality of the water cannot properly be given as the cause; since no fishes imbibe any of the sea's saltness with their food, or in respiration. The flesh of all fishes is equally fresh, both in the river, and in the saltest depths of the ocean; the salt of the element in which they live no way mixing with their constitution. Whence then is it that animals will live only there, and will quickly expire when carried into fresh water? It may probably arise from the superior weight of the sea-water; as from the great quantity of salt dissolved in its composition, it is much heavier than fresh water, so it is probable it lies with greater force upon the organs of respiration, and gives them their proper and necessary play; on the other hand, those fish which are used only to fresh water, cannot bear the weight of the saline fluid, and expire, in a manner suffocated in the grossness of the strange element.

But though there are some tribes that live only in the sea, and others only in fresh water, yet there are some whose organs are equally adapted to either element; and that spend a part of their season in one, and a part in the other. Thus the salmon, the shad, the smelt, and the flounder, annually quit their native ocean, and come up our rivers to deposit their spawn. This seems the most important business of their lives; and there is no danger which they will not encounter, even to the surmounting precipices, to find a proper place for the deposition of their future offspring. The salmon, upon these occasions, is seen to ascend rivers five hundred miles from the sea; and to brave not only the danger of various enemies, but also to spring up cataracts as high as a house. As soon as they come to the bottom of the torrent, they seem disappointed to meet the obstruction, and swim some paces back: they then take a view of the danger that lies before them, survey it motionless for some minutes, advance, and again retreat; till at last summoning up all their force, they take a leap from the bottom, their body straight, and strongly in motion; and thus most frequently clear every obstruction. It sometimes happens, however, that they want strength to make the leap; and then, in our fisheries, they are taken in their descent. But this is one of the smallest dangers that attend these adventuring animals in their progress: numberless are the methods of taking them; as well by the hook, as by nets, baskets, and other inventions, which it is not our business here to describe. Their capture makes, in several countries, a great article of commerce; and being cured in several different manners, either by salting, pickling, or drying, they are sent to all the markets of Europe.

As these mount up the rivers to deposit their spawn, others, particularly the eel, descend the fresh water stream, as Redi assures us, to bring forth their young in the sea. About the month of August, annually, these animals take the opportunity of the most obscure nights, and when the rivers are flooded by accidental rains seek the ocean. When they have reached the sea, and produced their young, for they are viviparous, they again ascend the stream, at different times, as opportunity offers, or as the season is favourable or tempestuous. Their passage begins usually about the end of January, and continues till towards the end of May, when they are taken in the river Arno by millions, and so small that a thousand of them goes to a pound. There is nothing more certain than that they descend our own rivers after floods in great abundance, and are thus caught in nets to very great advantage. They are possessed also of a power of climbing over any obstacle; for, by applying their glutinous and slimy bodies to the surface of the object they desire to surmount, they can thus creep up locks, weirs, and every thing that would prevent their ascending the current of the stream.

But the length of the voyage performed by these fishes, is short, if compared to what is annually undertaken by some tribes, that constantly reside in the ocean. These are known to take a course of three or four thousand miles in a season, serving for prey to whales, sharks, and the numerous flocks of water-fowl, that regularly wait to intercept their progress. These may be called fish of passage, and bear a strong analogy to birds of passage, both from their social disposition, and the immensity of their numbers. Of this kind are the cod, the haddock, the whiting, the mackarel, the tunny, the herring, and the pilchard. Other fish live in our vicinity, and reside on our coasts all the year round; or keep in the depths of the ocean, and are but seldom seen: but these, at stated seasons, visit their accustomed haunts with regular certainty, generally returning the same week in the succeeding year, and often the same day.

The stated returns, and the regular progress of these fish of passage, is one of the most extraordinary circumstances in all the history of nature. What it is that impels them to such distant voyages; what directs their passage; and what supports them by the way; and what sometimes prompts them to quit, for several seasons, one shore for another, and then return to their accustomed harbour; are questions that curiosity may ask, but philosophy can hardly

resolve. We must dismiss inquiry, satisfied with the certainty of the facts.

The cod seems to be the foremost of this wandering tribe, and is only found in our northern part of the world. This animal's chief place of resort is on the banks of Newfoundland, and the other sand-banks that lie off Cape Breton. That extensive flat seems to be no other than the broad top of a sea-mountain, extending for above five hundred miles long, and surrounded with a deeper sea. Hither the cod annually repair in numbers beyond the power of calculation, to feed on the quantity of worms that are to be found there in the sandy bottom. Here they are taken in such quantities, that they supply all Europe with a considerable share of provision. The English have stages erected all along the shore for salting and drying them; and the fishermen, who take them with the hook and line, which is their method, draw them in as fast as they can throw out. This immense capture, however, makes but a very small diminution when compared to their numbers; and when their provision there is exhausted, or the season for propagation returns, they go off to the polar seas, where they deposit their roes in full security. From thence want of food forces them, as soon as the first more southern seas are open, to repair southward for subsistence. Nor is this fish an unfrequent visitant upon our own shores: but the returns are not so regular, nor does the capture bear any proportion to that at Newfoundland.

The haddock, the whiting, and the mackerel are thought by some to be driven upon our coasts rather by their fears than their appetites; and it is to the pursuit of the larger fishes we owe their welcome visits. It is much more probable, that they come for that food which is found in more plenty near the shore than farther out at sea. One thing is remarkable, that their migrations seem to be regularly conducted. The grand shoal of haddocks that comes periodically on the Yorkshire coasts, appeared there in a body on the tenth of December, 1766; and exactly on the same day in the following year. This shoal extended from the shore near three miles in breadth, and in length for more than forty. The limits of a shoal are precisely known; for if the fishermen put down their lines at the distance of more than three miles from shore, they catch nothing but dog-fish: a proof that the haddock is not there.

But of all migrating fish, the herring and the pilchard take the most adventurous voyages. Herrings are found in the greatest abundance in the highest northern latitudes. In those inaccessible seas, that are covered with ice for a great part of the year, the herring and pilchard find a quiet and sure retreat from all their numerous enemies; thither neither man, nor their still more destructive enemy, the fin-fish, or the cachalot, dares to pursue them. The quantity of insect food which those seas supply, is very great; whence, in that remote situation, defended by the icy rigour of the climate, they live at ease, and multiply beyond expression. From this most desirable retreat, Anderson supposes they would never depart, but that their numbers render it necessary for them to migrate; and, as with bees from a hive, they are compelled to seek for other retreats.

For this reason, the great colony is seen to set out from the icy sea about the middle of winter; composed of numbers, that if all the men in the world were to be loaded with herrings, they would not carry the thousandth part away. But they no sooner leave their retreats, but millions of enemies appear to thin their squadrons. The fin-fish and the cachalot swallow barrels at a yawn; the porpoise, the grampus, the shark, and the whole numerous tribe of dog-fish, find them an easy prey, and desist from making war upon each other; but, still more, the unnumbered flocks of sea-fowl, that chiefly inhabit near the pole, watch the outset of their dangerous migration, and spread extensive ruin.

In this exigence the defenceless emigrants find no other safety but by crowding closer together, and leaving to the outmost bands the danger of being first devoured; thus, like sheep when frighted, that always run together in a body, and each finding some protection in being but one of many that are equally liable to invasion, they are seen to separate into shoals, one body of which moves to the west, and pours down along the coasts of America, as far as south Carolina, and but seldom farther. In Chesapeak Bay, the annual inundation of these fish is so great, that they cover the shores in such quantities as to become a nuisance. Those that hold more to the east, and come down towards Europe, endeavour to save themselves from their merciless pursuers, by approaching the first shore they can find; and that which first offers in their descent, is the coast of Iceland, in the beginning of March. Upon their arrival on that coast, their phalanx, which has already suffered considerable diminutions, is nevertheless, of amazing extent, depth, and closeness, covering an extent of shore as large as the island itself. The whole water seems alive; and is seen so black with them to a great distance, that the number seems inexhaustible. There the porpoise and the shark continue their depredations; and the birds devour what quantities they please. By these enemies the herrings are cooped up into

so close a body, that a shovel, or any hollow vessel, put into the water, takes them up without farther trouble.

That body which comes upon our coasts, begins to appear off the Shetland isles in April. These are the forerunners of the grand shoal which descends in June; while its arrival is easily announced, by the number of its greedy attendants, the gannet, the gull, the shark, and the porpoise. When the main body is arrived, its breadth and depth is such as to alter the very appearance of the ocean. It is divided into distinct columns, of five or six miles in length, and three or four broad; while the water before them curls up, as if forced out of its bed. Sometimes they sink for the space of ten or fifteen minutes, then rise again to the surface; and, in bright weather, reflect a variety of splendid colours, like a field bespangled with purple, gold, and azure. The fishermen are ready prepared to give them a proper reception; and, by nets made for the occasion, they take sometimes above two thousand barrels at a single draught.

From the Shetland isles, another body of this great army, where it divides, goes off to the western coasts of Ireland, where they meet with a second necessity of dividing. The one takes to the Atlantic, where it is soon lost in that extensive ocean; the other passes into the Irish sea, and furnishes a very considerable capture to the natives.

In this manner the herrings, expelled from their native seas, seek those bays and shores where they can find food, and the best defence against their unmerciful pursuers of the deep. In general, the most inhabited shores are the places where the larger animals of the deep are least fond of pursuing; and these are chosen by the herrings as an asylum from great dangers. Thus, along the coasts of Norway, the German shores, and the northern shores of France, these animals are found punctual in their visitations. In these different places they produce their young; which, when come to some degree of maturity, attend the general motions. After the destruction of such numbers, the quantity that attempts to return is but small; and Anderson doubts whether they ever return.

Such is the account given of the migration of these fishes, by one who, of all others, was best acquainted with their history; and yet many doubts arise, in every part of the migration. The most obvious which has been made is, that though such numbers perish in their descent from the north, yet, in comparison to those that survive, the account is trifling: and it is supposed, that of those taken by man, the proportion is not one to a million. Their regularly leaving the shore also at a stated time, would imply that they are not in these visits under the impulse of necessity. In fact, there seems one circumstance that shows these animals governed by a choice with respect to the shores they pitch upon; and not blindly drove from one shore to another. What I mean, is their fixing upon some shores for several seasons, or, indeed, for several ages together; and, after having regularly visited them every year, then capriciously forsaking them, never more to return. The first great bank for herrings was along the shores of Norway. Before the year 1584, the number of ships from all parts of Europe that resorted to that shore exceeded some thousands. The quantity of herrings that were then assembled there was such, that a man who should put a spear in the water, as Olaus Magnus asserts, would see it stand on end, being prevented from falling. But soon after that period, these animals were seen to desert the Norway shores, and took up along the German coast, where the Hanse-Towns drove a very great trade by their capture and sale; but, for above a century, the herrings have, in a great measure forsaken them; and their greatest colonies are seen in the British channel, and upon the Irish shores. It is not easy to assign a cause for this seemingly capricious desertion: whether the number of their finny enemies, increasing along the northern coasts, may have terrified the herring tribe from their former places of resort; or, whether the quantity of food being greater in the British Channel, may not allure them thither; is not easy to determine.[1]

[1] The *Herring*, with the pilchard, sprat, shad, anchovy, and white-bait, belongs to the Clupeæ genus. It weighs about five ounces and a half. The upper part of the



body is blue or dark green, and the lower parts of a silvery white. Owing to the gill-lids being very loose and opening wide, the herring dies almost the instant it is taken out of the water; hence, perhaps, the saying, "as dead as a herring." In twenty-four hours the gill-covers present an extravasated appearance.

The herring is not found in warm regions, nor farther south than the northern coasts of France. The most interesting point connected with its natural history is the annual movement which it makes. Pennant, whose zoological labours entitle him to much respect, about the middle of the last century gave an account of their periodical migration, which has been implicitly copied by nearly every succeeding writer, Goldsmith among the rest. In a work on subjects of marine natural history, published quite recently, Pennant's account is substantially repeated, and it is stated in addition that the different columns of herrings, in the course of their migrations, are led by herrings of more than ordinary size. Other writers have stated that the annual visitations of the herring are adjusted with the most scrupulous precision to the character of the country along which they pass, and that wherever the soil is meagre and the climate severe, there they never fail to resort. This is going much

The pilchard, which is a fish differing little from the herring, makes the coast of Cornwall its place of principal resort. Their arrival on that coast is soon proclaimed by their attendants the birds and the larger fishes; and the whole country prepare to take the advantage of this treasure, providentially thrown before them. The natives sometimes enclose a bay

farther than Mr Pennant, who notices the caprice which the herrings exercise with regard to their haunts. The promulgation of these and similar erroneous notions is productive of mischief in various ways. The belief that a particular part of the coast was invariably haunted by the herrings, excited hopes of commercial prosperity from the fishery, and led to the formation of establishments which it was afterwards found necessary to abandon, owing to the laws which direct the arrival of the fish being so completely fluctuating. Factitious views of the designs of Providence have been taken, which, being founded on error, were liable to be suddenly overthrown; whereas, within the bounds of ascertained facts, there are to be found abundant manifestations of beneficent design, the evidence of which rests upon a more secure foundation. The very uncertainty which characterizes the herrings in the choice of their haunts is attended with advantage, as it occasions attention to be directed to agriculture and to other means of subsistence than that which the ocean supplies, and thus the chances of scarcity are lessened.

So far from the arctic seas being the great resort to which the herrings retire for the winter after having deposited their spawn, it is nearly certain that they are not in the habit of leaving the seas on the shores of which they periodically appear. They leave the shore for the deep sea, and the return of warm weather again brings them around the coasts. The herring, it may also be stated, is nearly unknown within the polar seas, and has scarcely been observed by the navigators of those regions; nor are they taken by the Greenlanders. A small variety of the herring is sometimes found, and is noticed by Sir John Franklin. The young are found at the mouth of the Thames, and on the coasts of Essex and Kent during the winter. The Dutch at one period carried on the fishery in the deep sea at all seasons. On the western coast of Scotland the fishery has sometimes terminated before that on the eastern coast has commenced. It has sometimes commenced earlier in a southern part of the coast than further north, and on the western coast of the county Cork before any other part of the united kingdom. These facts are all adverse to the accounts which have been given of a grand movement in military order from the Arctic seas. On the east coast of Scotland the herrings often spawn at a different period from those which resort to the western coast, and at the same time their condition is quite dissimilar. Mr Jesse, in his "Gleanings in Natural History," states that the herrings of Cardigan bay are much superior to those taken at Swansea. Dr John Macculloch is of opinion that this may arise from their obtaining more abundant or different food. He states that in Scotland no migration takes place even between the two coasts, and that when the herrings first appear on the western coast it is not in shoals; and instead of being taken by the net, they are taken by the line. Sir Humphry Davy has remarked as follows in his "Salmonia:"—"It has always appeared to me, that the two great sources of change of places of animals, was the providing of food for themselves, and resting-places and food for their young. The great supposed migrations of herrings fron the poles to the temperate zone, have appeared to me to be only the approach of successive shoals from deep to shallow water, for the purpose of spawning." The presumption, therefore, is that the herring is a permanent inhabitant of our seas, and that there are different varieties of the species. Mr Yarrell says:—"There are three species of herrings said to visit the Baltic, and three seasons of roe and spawning. The stromling, or small spring herring, spawns when the ice begins to melt; then a large summer herring; and lastly, towards the middle of September, the autumn herring makes its appearance and deposits its spawn." The same naturalist has discovered what he believes to be a second species of British herring: it is found heavy with roe at the end of January, which it does not deposit till the middle of February. The flavour is milder than that of the common herring, but it is not so large, its length being seven inches, and its depth two.

The frequent changes of their haunts by herrings have been a fruitful source of speculation, though this fact is adverse to the accounts which give to their migration all the regularity which would seem to belong to so well organized an army. At one time they frequent a particular part of the coast for several years, and they afterwards suddenly abandon it. The change is doubtless occasioned by circumstances which it is their nature to obey. In the time of Charles I. the Long island, one of the western islands of Scotland, was a favourite resort of the herring, and buildings were erected for the purpose of establishing a fishery, but it was abandoned in consequence of the fish ceasing to frequent that part of the coast. Dr Macculloch, in his work on the "Highlands and Western isles of Scotland," has introduced some remarks which are too apt to be omitted in this place. "As vulgar philosophy (he says) is never satisfied unless it can find a cause for everything, this disappearance of the herring has been attributed to the manufacture of kelp. But kelp was not introduced for very many years after the herrings had left the Long island, as well as many other coasts which they had frequented. It is also a popular belief that naval engagements, or even the firing of guns, cause them to change their haunts. Thus their desertion of Sweden was attributed to the battle of Copenhagen; and now, when guns are at peace, the steam-boats are the 'sufficient reason.' The one reason is as valid as the other. It is a chance if there has been a gun fired in the western islands since the days of Cromwell, and they have shifted their quarters within that period many a time. They have long left loch Hourn, and loch Torridon, where steam-boats never yet smoked; and since the steam-boat has chosen to go to Inverary, they have also thought fit to prefer loch Fyne to all the western bays. But theories like this have at least the merit of antiquity. Long before the days of gunpowder, the ancient highlanders thought that the fish deserted those coasts where blood had been shed; so that the gun hypothesis is only an old one revived, with the necessary modifications."

Assuming that the herring approaches our shores from the deep surrounding seas, and does not migrate from the polar seas alone, there are three different circumstances which may occasion its movements:—1. For the purpose of spawning. 2. In pursuit of food. 3. To escape from enemies which prey upon them.

The herring spawns towards the end of October or the beginning of November; and for the purpose of vivification, it is necessary that it should be deposited in shallow water, where it may receive the heat of the sun. This instinctive movement is felt in the middle of July, and they are thus brought within the reach of man when they are in the highest perfection. They are worthless as food after having deposited their spawn, and the fishing season of course terminates. Mr Yarrell is of opinion, from repeated examinations, that the herringsile, or young herrings, do not mature any roe during their first year; and hence they are not impelled to retire to the deep sea, but haunt the coasts. The weight of spawn in the herring is 480 grains, and the number of eggs between 3000 and 4000. This spawn has been thrown ashore in Ork

of several miles extent with their nets called *saines*. To direct them in their operations, there were some years ago (but I believe they are discontinued) several men placed on eminences near the shore, called *huers*, who, with brooms in their hands, gave signals where the nets were to be extended, and where the shoals of fishes lay: this they perceived by the colour

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ney, found around the isle of Man and all along the western shores of Scotland, and in the western lochs. A greater degree of observation would most probably prove that it is deposited around the British coasts generally, particularly the coast of Scotland.

Fishermen have remarked that the herring was most abundant where the medusæ, and other marine animals which give the sea a luminous appearance, were to be found. The movements of herrings are doubtless frequently determined by the time and place where food is abundant. If it is not to be found in one spot it must be sought for in another; and the apparent caprice which they show in frequenting places at irregular times and irregular intervals, is determined by a provident regard to the abundance of food with which those places are supplied.

Lastly, in endeavouring to escape from whales, grampuses, sharks, and other enemies, the movements of the herring are the result of necessity; and nothing seems more unlikely than that they should, under such circumstances, display an instinctive attachment to particular places.

Herrings enter the Frith of Forth about the end of December or the beginning of January, and remain two or three weeks at the mouth of the estuary before they attempt to ascend. This delay seems greatly to depend on the state of the weather, for in some seasons when it is mild and fine, the herring has been observed to swarm in the Frith off Musselburgh in the early part of January; whilst in the rough and stormy seasons they do not make their appearance in that part of the river before the middle of February, and always disappear before the end of March. They seem to visit the Frith regularly every winter, and a season very seldom passes without a few being captured and sent to the Edinburgh market. Some years they appear in much larger shoals than in others, the reason of which is not accounted for. In the year 1816, pilchards were taken in the Frith of Forth in great abundance, when not a dozen herrings were seen during the whole winter. Since that time not a single pilchard has been known to enter the estuary.

In June, July, and August, herring are taken off the Dunbar and Berwick coasts in considerable number, from whence the Edinburgh market is abundantly supplied, when scarcely a single herring is to be seen higher in the Frith of a size worth the notice of the fishermen.

Herrings are said to deposit their spawn towards the end of October, but this spawning does not account for the number of small fry, two inches in length, that are found in the Frith of Forth during the month of July; and the young herrings that are taken from six to seven inches long in the month of February, mixed with fry from two to three inches in length. When herrings are brought to the market in the first two months of the year, they are found full of spawn, and in the middle of March they are observed to be very lank, with not a single ovum to be seen. Hence it is not improbable, that the same species of herring might spawn twice in the year, early in the month of March and also towards the end of October.

The most common length of a full-grown herring is eleven inches, and two and a quarter deep. Each jaw on the anterior part is furnished with six or eight teeth placed in one row, which are more perceptible on the lower than on the upper jaw; the vomer is supplied with a double row, about sixteen in number; on each side is another row of teeth, which are rather smaller; the tongue is also armed with teeth, arranged in three or four rows, with their points directed inwards; the under jaw is longest, and is tipped with black; eyes large and silvery, placed nearer to the point of the nose than to the posterior margin of the operculm. The first ray of the dorsal fin in an adult fish arises exactly half way between the point of the upper jaw and the base of the middle caudal rays; the origin of the ventral fins is placed behind the third dorsal ray, half way between the point of the lower jaw, and a little beyond the end of the middle caudal rays.

The tail is deeply forked, the middle rays less than half the length of the longest ray of the same fin; the second ray of the dorsal fin, a little longer than the base of that fin; the scales are large, oval, and very deciduous, placed in fifteen rows between the dorsal and ventral fins. Most authors suppose that the belly of the herring is not serrated in any stage of its growth, which is said to form a good specific distinction between it and the sprat; but it will be found that this is not the case, for a herring less than six inches in length is as distinctly serrated on the belly with thirty-six teeth, between the ventral and anal fins, as a sprat of equal size; but as the herring increases in size, so the serratures become obliterated, and, by the time the fish reaches to the length of eight inches, the belly will be found to be no longer serrated, but carinated.

The most prominent specific distinction of the herring, from the sprat, white-bait, and pilchard, is in the position of the dorsal fin, which is placed exactly in the middle of the fish, half way between the point of the upper jaw, and the end of the longest caudal ray.

Dr Knox considers the food of the herring, while inhabiting the depths of the ocean, to consist principally of minute entomostracous animals; but it is certainly less choice (adds Mr Yarrell) in its selection when near the shore. Dr Neill found five young herrings in the stomach of a large female herring; he has also known them to be taken by the fishermen on their lines, the hooks of which were baited with limpets. The young of the white-bait and small shrimps are often found in the stomach of herrings when they are not in roe; but when they are about to spawn, their stomachs (as is observed in most other fishes at that period,) appear as if empty and destitute of any perceptible food. On the authority of Dr Fleming the fry have even been caught with a trout-fly.

On the coasts of the West Highlands, herrings for many years past have been taken with the rod, the hook dressed with a white feather (generally from some of the gulls.) Near Oban, and upon the shores of Mull and Jura, twelve dozen are sometimes taken by a single boat during the evening.

Mode of taking and curing Herrings.—The herring-fishery is only carried on during the spawning season, when the fish are in the highest perfection. The Yarmouth herring-fishery commences about the middle of September, but the season varies at different parts of the coast. On the coast of Sutherland the early herring-fishery commences in June; the late fishery about the middle of July, and continues until September. On the coast of Cromarty large shoals appear as early as the month of May. The great object is to obtain a supply for the purpose of curing, although, in the early part of the season, large numbers of fresh herrings are brought to the London market from Yarmouth; and the consumption at Norwich and other places, which are not at a great distance from the coast, is also considerable. The fish are sometimes so rich in the early part of the season as to be unfit for curing, and on this account they are brought into the market for immediate

of the water, which assumed a tincture from the shoals beneath. By these means, they sometimes take twelve or fifteen hundred barrels of pilchards at a draught; and they place them in heaps on the shore.—It often happens that the quantity caught exceeds the salt or the utensils for curing them; and they then are carried off to serve for the purposes

consumption. The spawning season being over by the end of October or the beginning of November, the fishing terminates, as the herrings are then in a poor and exhausted condition.

The description of vessel fitted out for the herring-fishery on the eastern and western coasts of Scotland is called a "buss," of from fifty to eighty tons burden, cutter built. They ply from loch to loch in pursuit of the herrings, and come to anchor in the nearest harbour when the fish appear. A man or two is left on board the buss to take charge of her, and the rest go out in the boats, each manned with four hands, for the purpose of setting the nets. Each boat has two trains of nets, 230 or 240 yards long, and from eleven to twelve yards deep. In deep water both trains are tied together by the back-rope, one end to windward and the other to leeward. The boats are fastened at each end and allowed to drive to leeward with the nets. Every half-hour, or oftener, the men endeavour to ascertain if there are any herrings in the net. This they do by following along the line of the back-rope, and here and there raising a piece of netting. By this means they not only find when they are upon good fishing-ground, but learn whether the herrings swim high or low, and they raise or sink the nets accordingly, by shortening or lengthening the buoys by which the nets are kept up. Sometimes they traverse ten or twenty miles in a night, setting their nets ten or twelve times in different places. The fishing is never carried on but in the night, and the darkest nights, accompanied by a slight breeze, are the most propitious. In the morning, at daylight, the fishermen take their cargo to their respective busses. When the herrings are in great numbers, their labours are comparatively light. The nets are set in the evening, a small anchor is fixed to each end of the train, and they are not hauled or raised until morning. In this case the trains are not joined together, but are set separately, and near the buss, on board of which the men sleep. The crews of the busses are engaged by the month, and a great proportion of them are landsmen, pursuing other labours when the fishing season is over. Each man receives, in addition to his wages, a certain quantity of herrings, when the season is a good one, and a smaller proportion when it is unfavourable.

The Dutch Herring Fishery.—Mr William Chambers, in his Recollections of a Continental Tour, gives an interesting description of the Dutch herring fishery. "The Dutch greatly excel," he says, "in the art of curing herrings. The herring in a salted state is the animal delicacy of Holland, and enjoys a very different estimation from that of the common salt herring in Britain. Yet the fish of both countries are the same, being caught in the same fishing-grounds; and there is no reason why our herrings should be in any respect inferior in quality and mercantile value. There are about eighty vessels employed in the Dutch herring fishery, nearly all of which belong to Vlaardingen and Maas-sluis, two ports on the Maas, situated between Rotterdam and the sea. The fishing is conducted on an organized plan. All the vessels set sail on a fixed day, namely, the 15th of June, which is held as a day of rejoicing and merriment. They are accompanied by a vessel of war, which carries a chaplain for the fleet; and to this vessel, at the beat of drum, the fishermen proceed on Sundays for public worship. The fishing-grounds are towards the northern coasts of Scotland; but agreeably to a law of old standing, no vessel is expected to approach within three leagues of the shore. The first day that nets are allowed to be hauled is the 24th of June, when the fishing at once commences in all its vigour. The whole process of curing is conducted on shipboard. Immediately on being caught, the herrings are bled, gutted, cleaned, salted, and barrelled. The bleeding is effected by cutting them across the back of the neck, and then hanging them up for a few seconds by the tail. By being thus relieved of the blood, the fish retain a certain sweetness of flavour or delicacy of flesh which unbled herrings cannot possibly possess. The rapidity of the process of curing must likewise aid in preserving the native delicacy of the animal, for the herring is salted and in the barrel in a very few minutes after it has been swimming in the water. The superiority of the Dutch herrings, I was assured, is solely ascribable to this mode of curing, though it is not unlikely that something is also owing to the nature of the salt employed, as I have somewhere seen it mentioned that the salt in use, in reference to other processes of curing in Holland, is of a less bitter quality than that which is commonly employed in this country. The first herrings caught and cured, to the extent of two or three barrels, are instantly dispatched by a fast-sailing vessel for Holland, where their arrival is anxiously expected. On landing at Maas-sluis, one barrel, decorated with flowers and with flags flying, is dispatched to the Hague as an offering to his majesty, who on this occasion presents the fortunate fishers with 1000 guilders. The other barrels are sold by public auction, and generally fetch from 900 to 1100 guilders. These precious barrels are then subdivided among the dealers, who retail them at a high price. A single herring of this first importation brings one and a half to two guilders—that is, half a crown to three shillings and fourpence each. So highly are they esteemed, that a single herring is considered a handsome present; and it is a custom to make such gifts to friends and acquaintances on this auspicious occasion. Livery servants may be seen passing through the streets with a plate, on which lie one or two herrings, covered with a fine white cloth and a neat card of presentation. When a second importation takes place, the price falls perhaps to a guilder, to half a guilder, to fivepence, and, finally, to a penny each. The period of my visit was shortly after the early importations of the herrings from the Dutch fleet, and I observed some shops still decorated with the gaudy crowns of flowers with which their exterior had been invested a few weeks before. Both in Holland and in the countries up the Rhine, I had an opportunity of seeing these delicious Dutch herrings brought to table. Two or three of them form a dish at dinner, and are partaken of as an entremet, or something tasteful between the courses. I observed that some persons at the table-d'hôtes began their meals by taking a small piece of them. They are always brought to the table raw, and cut across, as if crimped. At Rotterdam, on asking for one boiled, I shocked the feelings of our domestic attendant, who expressed no small degree of surprise at so singular a proposition."

The *Pilchard*, (*Clupea pilchardus*,) is a species of the herring-tribe, and differs from the common herring,



chiefly, in being rather shorter in the head, and thicker in the body, and in having its dorsal or back-fin, somewhat forwarder: but it may be more readily distinguished

of manure. This fishery employs not only great numbers of men at sea, training them to naval affairs, but also numbers of women and children at land, in salting and curing the fish; in making boats, nets, ropes, and casks, for the purposes of taking or fitting them for sale. The poor are fed with the superfluity of the capture; the land is manured with the

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by its scales, which are nearly half as large again as those of a herring of the same size. It is found, during the months of August and September, in great shoals, or *schools*, as they are called by the fishermen, on the south-west coast of England, and afford employment, for a time, to a great number of boats and men, belonging to the fishing-towns of Cornwall. This fish is also met with off the French coast, and other parts of Europe, but its chief place of resort appears to be the coasts of Cornwall and Devon. The pilchard is rarely met with in the London markets, but there is a fish, found sparingly among the sprats, which has obtained its name, which in reality, is merely a small, and we believe, undescribed species of herring. The value of this fishery was well known as long back as the reign of Elizabeth, when an act of parliament, containing the following clause, was passed :—"No stranger should transport beyond seas, any pilcherd or other fish in cask, vnlesse hee did bring into the realme for every sixe tunnes, two hundred of clap boord fit to make cask, and so rateably, vpon payne of forfeiting the said pilcherd or fish." The reason the *stranger* was obliged to bring in a certain quantity of wood, appears to have arisen from the circumstance of Cornwall being nearly without timber of any kind.

There are several signs by which the presence of a shoal of pilchards may be known; the luminous appearance of the sea at night, the number of birds of prey which accompany it, and, when seen from a moderate distance, the appearance of the water, which seems for miles around to be, as it were, boiling or bubbling.

When the annual visit of the pilchards is expected, to prevent their passing unnoticed, men are continually on the alert, watching from all the elevated spots on the coast, from which stations they are also able by signs to direct the operations of their friends at sea, so that they may be enabled to enclose as many of the fish as possible. The largest net which is employed, is called a *sean*, and is upwards of sixty fathoms (three hundred and sixty feet,) in length, and thirty-six feet in depth; the lower part of this net is kept down by means of leaden weights, while the upper floats on the surface, being rigged out with a number of corks; if one of these nets is found to be insufficient for the purpose of surrounding the shoal, a second, or even a third, is attached to it. The *sean* now forms a kind of wall, within which the fish are enclosed, and the object of the fishermen is to bring this net as near as possible to the shore, so that at low water, the fish shall have all means of escape cut off, except by overleaping the net. As soon as the tide is out, a net called a *truck-net*, which differs from the *sean* in being smaller, and without leads, is cast among the pilchards, and, cords being attached to its four corners, it is hauled on shore, along with as many fish as it may happen to contain; and this is repeated until the whole of them are taken or have made their escape.

While these means are employed for the capture of the larger quantity, other boats are engaged in taking the scattered parts of the shoal by means of driving-nets. The boats and nets of the *seaners* being very expensive, are generally provided by some capitalist or company of proprietors, and the men during the season are paid a small weekly sum, and also a certain portion of the captured fish. As soon as they are brought on shore, they are carried off in baskets to the curing-house, where they are carefully laid in rows one above the other, with alternate layers of salt, till a pile of considerable height is formed. They are said now to be in *bulk*, and are allowed to remain in this state from a fortnight to five weeks. During this time a quantity of brime and oil has drained from them, which runs off through gutters in the floor and is carefully collected; they are next thrown into a large wooden trough which contains a false bottom formed of battens or long strips of wood, and are freed from the salt and impurities that are attached to them; they are now very carefully and neatly packed in hogsheads, arranged in circles, one within the other, the heads all pointing inwards.

As soon as the hogshead is full, a circular board is placed on the top of the fish, and they are pressed very closely together by the application of heavy weights, the weights being large blocks of granite. This pressure reduces the bulk of the fish by nearly one third, and the hogshead has to be filled up three times before it is considered well packed. A quantity of pure oil runs off, during this part of the process, through a small hole in the bottom of the cask. It is calculated, that a hogshead of pilchards which weigh about four hundred weight and a quarter, will yield from three to four gallons of oil, worth about £17 a tun, or rather better than 1*s*. 4*d*. a gallon.

The oil is used in the manufacture of cart-grease, and for many other purposes to which the more common kind of whale-oil, called train-oil, is applied. Attempts have been made to purify this oil, so as to render it serviceable to the currier, but hitherto without success, on account of the quantity of salt and glutinous matter which it contains. The pilchards, when thus packed, are exported chiefly to the West Indies, for the use of the slave-population, and to different parts of the Mediterranean and are likewise salted and dried in great quantities for winter-provision, by the poorer classes in Cornwall and Devon.

The myriads of fish that a shoal of pilchards contains, are almost beyond the power of calculation; some of the shoals will form almost solid masses, covering a surface frequently of six square miles, and extending in depth upwards of one hundred feet. In successful times, as many as from five to seven hundred hogsheads have been taken from one shoal. The annual value of the fish that are exported is from fifty to sixty thousand pounds.

The appearance of a shoal of pilchards on a dark night, when enclosed by the nets, is splendid beyond description; struggling and leaping in every direction, to escape from their confinement, or to avoid the attacks of their numerous enemies (particularly the dog-fish,) who are imprisoned along with their victims, they appear like so many flakes of fire, and the sea itself seems like a lake of liquid flame.

The pilchard fisheries, according to evidence laid before a committee of the house of commons, appear, of late years, to have decreased considerably. Several causes have tended to produce this state of the fishery; among others, the removal of a bounty of 8*s*. 6*d*. a hogshead, which had been paid to the exporters till within these five or six years, and the increase of duty at present is as much as 18*s*. 2*d*. a hogshead, imposed by the government at Naples, to which place large quantities were exported.

The fishery is also injured by the illegal practice of employing drift and other nets too near the shore, by which means the shoals are dispersed as they approach. It is likely, however, that the statute of the 14th of Charles II. will soon be more strictly enforced. This Act imposes a fine upon all persons who "shall in any year, from the first of June till the last day of November, presume to take fish in the high sea, or in any bay, port, creek, or coast, of or belonging to Cornwall and Devon, with any drift-net, trammel, or

offals; the merchant finds the gain of commission, and honest commerce; the fisherman a comfortable subsistence from his toil. "Ships," says Dr Borlase, "are often freighted hither with salt, and into foreign countries with the fish, carrying off at the same time a part of our tin. The usual produce of the number of hogsheads exported for ten years, from 1747

stream-net or nets, or any other nets of that sort or kind, unless it be at the distance of one league and a half at least from the respective shores."

The number of boats at present engaged in this fishery is about 1000, giving employment to 3500 men at sea, and upwards of 5000 men, women, and children, on shore.

The *White-bait* (*Clupea alba*,) which is found so plentifully in the Thames, and is so well known in the



neighbourhood of London, as a delicate and well-flavoured fish, was supposed by naturalists to be the young of the shad, until Mr Yarrell, in the Magazine of Natural History, proved it to be a distinct species. In many respects it differs materially from all the other British species of Clupea, not only in specific characters, but also in its habits, and is one as distinctly marked as any of its congeners. From the beginning of April to the end of September, this fish, according to Mr Yarrell, may be caught in the Thames as high up as Woolwich or Blackwall, every flood tide, in considerable quantity; while during the first three months of this period, neither species of the genus Clupea of any age or size, except occasionally a young sprat, can be found. About the end of March, or early in April, white-bait begin to make their appearance in the Thames, and remain till the end of September, when they are no longer to be found in the river. In the months of June, July, and August, provided the weather be fine, immense quantities are consumed by visitors to Greenwich and Blackwall, where epicures of all orders assemble for a white-bait feast. The fishery for these fish is continued in the Thames frequently so late as September, and specimens of young fish of the year, from four to five inches long, are then not uncommon, but mixed, even at this late period of the season, with others of very small size, as if the roe had continued to be deposited throughout the summer.

The white-bait (says Dr Parnell, in a communication in the first volume of the Magazine of Zoology and Botany, to which we are indebted for the present account) is not, as it was formerly considered to be, peculiar to the Thames, as I have found it to inhabit the Frith of Forth in considerable numbers during the summer months. From the beginning of July to the end of September they are found in great abundance in the neighbourhood of Queensferry, and opposite Hopetoun House, where I captured on one dip of a small net, of about a foot and a half square, between two and three hundred fish, the greater part of which were white-bait of small size, not more than two inches in length: the remainder were sprats, young herring, and fry of other fish. In their habits they appear to be similar to the young of the herring, always keeping in shoals, and occasionally swimming near the surface of the water, where they often fall a prey to aquatic birds.

I have no doubt (continues Dr Parnell) that the white-bait will be found to exist in the Frith of Forth* throughout the whole of the year in considerable quantity, and that the fishermen would find it a new source of income, equal or superior to the spirling fishery, did they use the mode of fishing for white-bait that is practised in the Thames. But in consequence of the large extent of the estuary, and of no means being used exclusively for the capture of these fish, we can form but a faint idea of the number that may there exist.

The white-bait net which is used in the Thames is not large; the mouth of it measures only about three feet across, but the mesh of the hoes, or bag-end of the net, is very small. A boat is moored in the tide-way, where the water is from twenty to thirty feet deep; and the net with its wooden frame is fixed to the side of the boat. The tail of the hose, swimming loose, is from time to time brought into the boat, the end untied, and its contents shaken out. The wooden frame forming the mouth of the net does not dip more than four feet below the surface of the water.

The largest specimen of Clupea alba that I have met with, taken from the Frith of Forth, measures five inches in length. The upper part of the back, from the nape to the tail, is of a pale greenish ash-colour, the sides, gill covers, pectoral, ventral, and anal fins, of a beautiful pure white; the dorsal and caudal fins straw colour, minutely spotted with dark brown. The head on the summit in young specimens is marked with a large brown spot, which is divided anteriorly by a white line. Each orbit on the superior margin is tinged with black, as well as the posterior inferior margin, but in a less degree. The shape of the body resembles that of the young herring, but it is more compressed and of a deeper form.

The first ray of the dorsal fin commences exactly midway between the point of the upper jaw and the end of the middle caudal ray; the ventral fins are placed behind the third ray of the dorsal; the tail is deeply forked, the middle ray being not quite half the length of the longest ray of the same fin.

The head, in a specimen five inches long, is not quite one-fourth the length of the whole fish. In a fish four inches long, the head is exactly one-fourth the entire length. In one two inches long, the head measures more than one-fourth the whole length. Each jaw on the anterior part is furnished with a few small slender teeth, about six in number, placed in one row; which are more perceptible on the lower than on the upper jaw; on the roof of the mouth as well as on the tongue, are placed three or more rows of teeth, which can be easily felt by the assistance of the point of a needle. In this respect my observations differ from those of Mr Yarrell, who says, the tongue of the white-bait has an elevated central ridge without teeth; but it is probable that that author did not examine a dried specimen, for until in that state, it is almost impossible to perceive the teeth, in consequence of their extreme minuteness. This is a most important character, and at once removes it from the shad, which has the tongue and roof of the mouth destitute of teeth.

The white-bait, four inches long, differs from the herring, sprat, and pilchard of the same length, in the following characters:

The herring has the dorsal fin half-way between the point of the upper jaw and end of the long caudal rays; with the head nearly one-fifth the entire length. The white-bait has the dorsal fin much nearer the tip of the tail, than to the point of the upper jaw, with the head one-fourth the length of the whole fish; the body is more compressed, of a much lighter colour, and the belly much rougher under the pectorals, than is observed in the herring.

The sprat has the origin of the ventral fins situated

* The white-bait has also been observed by Dr Parnell in abundance in the Solway Frith.

to 1756 inclusive, amounted to nearly thirty thousand hogsheads each year; every hogshead has amounted, upon an average, to the price of one pound thirteen shillings and threepence. Thus the money paid for pilchards exported, has annually amounted to near fifty thousand pounds."

Whence these infinite numbers are derived, still remains obscure; but it will increase our wonder to be told, that so small a fish as the stickleback, which is seldom above two inches long, and that one would think could easily find support in any water, is yet obliged to colonize, and leave its native fens in search of new habitations. Once every seventh or eighth year, amazing shoals of these appear in the river Welland, near Spalding, and come up the stream, forming one great column. There are supposed to be multitudes collected in some of the fens, till overcharged with numbers, they are periodically obliged to migrate. An idea may be had of their numbers, when we are informed, that a man, employed by a farmer to take them, for the purpose of manuring his grounds, has got, for a considerable time, four shillings a day by selling them at a halfpenny a bushel!

Thus we see the amazing propagation of fishes along our own coasts and rivers; but their numbers bear no proportion to the vast quantities found among the islands of the Indian ocean. The inhabitants of these countries are not under the necessity even of providing instruments for fishing: it is but going down to the shore, and there the fish are found in great numbers in the plashes that still continue to have water in them. In some of these places the quantity is so great that they are left in shoals on those swamps, dried up by the sun, and their putrefaction contributes to render the country unhealthful.

This power of increasing in these animals, exceeds our ideas, as it would in a very short time outstrip all calculation. A single herring, if suffered to multiply unmolested and undiminished for twenty years, would show a progeny greater in bulk than ten such globes as that we live upon. But happily the balance of Nature is exactly preserved; and their consumption is equal to their fecundity. For this reason we are to consider the porpoise, the shark, or the cod-fish, not in the light of plunderers and rivals, but of benefactors to mankind. Without their assistance, the sea would soon become overcharged with the burden of its own productions; and that element, which

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anterior to a vertical line dropped from the first dorsal ray, with forty-eight vertebræ; the white-bait has fifty-six vertebræ, with the origin of the ventral fins placed behind the third ray of the dorsal. In the pilchard the dorsal fin is placed exactly in the centre of gravity, so that when the fish is held up by the anterior rays, the body preserves an equilibrium, whereas if the white-bait, herring, or sprat, be taken up by the same part, the head will be observed to dip considerably.

The stomach of the white-bait I have found frequently filled with minute crustacea.

Sprat or *Garvie Herring*, (*Clupea sprattus.*) This little fish, although well known to every one by the name of Sprat or Garvie herring, is not admitted by all to be a distinct species, being considered as the young of the pilchard or the herring. This mistake is not to be wondered at, since authors either omit the most important characters, or place reliance on characters which do not exist.

Sprats are found in the Frith of Forth, throughout the whole of the year, and, like many small animals, appear to be very susceptible of cold. During the warm summer months, they are seen sporting about in large shoals, in every part of the Frith, occupying a considerable extent of water, and causing a ripple on the surface with their fins, while they become the principal food of many marine birds, which assail them in the water, or prey on them from above. As the cold weather advances, these little fish are no longer seen in the lower part of the estuary, but are found to ascend the Frith to a considerable distance, and to select that part of the river where the fresh and salt waters mingle together; for it is a well known law in chemistry, that when two fluids of different densities come in contact, the temperature of the mixture is elevated for a time in proportion to the difference in density of the two fluids. Owing to mutual penetration and condensation, such a mixture is constantly taking place in the rivers that run into the sea, and the temperature of the mixed water is accordingly elevated. In the year 1830, the sprat was remarkably abundant all over the British coast, but more particularly on the coasts of Kent and Essex, where they were taken in immense quantity, so that they were sold at sixpence a bushel as manure for the land.

The sprat is generally considered as a delicious well-flavoured and wholesome fish, and is eaten in considerable quantity in this country, both in the fresh and salted conditions, but is very seldom brought to the Edinburgh market. They spawn early in the month of March, and feed on small crustaceous animals.

The most common size of a sprat is from four to five inches in length, but it is observed occasionally to exceed six inches and a half, when it is named in the neighbourhood of Alloa the King of Garvies.

The colour of the back is a deep glossy blue, the sides, belly, and gill-covers of a pure silvery white, passing into green and blue reflections, when viewed in different lights; the dorsal and caudal fins dusky, minutely spotted with black; the pectoral and ventral fins white, slightly tinged with orange. On the crown of the head is a dark spot placed between the eyes, which is very perceptibly seen when young, but as the fish increases in size the spot gradually becomes obliterated. The eye is large, the diameter being not less than one-fourth of the whole head; the upper and lower margins are tinged with black. Each operculum has a slight notch placed on its upper and posterior edge. The teeth in the jaws are small, slender, and few in number; they are situated on the most anterior parts, and are more obvious on the lower than on the upper jaw; the tongue as well as the roof of the mouth is also armed with fine teeth, their points being slightly bent inwards. The under jaw is the longest. The belly is strongly serrated as far as the anal aperture. The convexity of the dorsal and abdominal lines is much greater than is observed either in the white-bait or the herring.

The sprat differs from the herring, white-bait, pilchard, and shad, in two most striking characters; in having only forty-eight vertebræ, and in having the origin of the ventral fins placed before a vertical line dropped from the commencement of the first dorsal ray.

at present distributes health and plenty to the shore, would but load it with putrefaction.

In the propagation of all fish, some degree of warmth seems absolutely necessary, not only to their preservation, but to the advancement of their posterity. Their spawn is always deposited in those places where the sun beams may reach them, either at the bottom of shallow shores, or floating on the surface in deeper waters. A small degree of heat answers all the purposes of incubation, and the animal issues from the egg in its state of perfect formation, never to undergo any succeeding change.

Yet, still I have some doubts whether most fish come from the egg completely formed. We know that in all the frog tribe, and many of the lizard kind, they are produced from the egg in an imperfect form. The tadpole, or young frog, with its enormous head and slender tail, are well known; a species of the lizard also, which is excluded from the shell without legs, only acquires them by degrees, and not till after some time does it put off its serpent form. It is probable that some kinds of fish in like manner suffer a change; and though it be too inconsiderable to strike the fisherman or the inattentive spectator, yet it makes a very material difference to the naturalist, and would, perhaps, disarrange his most favourite systems. A slight alteration in the fins or bones that cover the gills would overturn the whole fabric of the most applauded ichthyologist; and yet, as I observed, it is most probable that these minute alterations often take place.

As a proof of this, during the month of July, there appear near Greenwich, innumerable shoals of small fishes, which are known to the Londoners by the name of White bait. It is universally agreed that they are the young of some fish; they are never seen but at this time of the year, and never found to have any roe, a circumstance that proves their not being come to maturity. The quantity is amazing; and the fish that produces them in such numbers must be in plenty, though it is not yet known what that fish is, as they correspond with no other species whatever. They most resemble the smelt in form; and yet they want a fin, which that animal is never without. They cannot be the bleak, as they are never found in other rivers where the bleak breed in great abundance. It is most probable, therefore, that they are the young of some animal not yet come to their perfect form, and therefore reducible to no present system.

The time that spinous fishes continue in the pea is in proportion to the size of the kind. It is a rule that chiefly holds through nature, that the larger the animals are, the longer they continue before exclusion. This I say holds generally through all nature, though it is not easy to assign a cause for so well known a truth. It may probably be, that as all large bodies take a longer time to grow hot than small ones, so the larger the egg, the longer influence of vital warmth it requires to reach through all its recesses, and to unfold the dormant springs that wait to be put into motion.

The manner in which the eggs of fishes are impregnated is wholly unknown. All that obviously offers is, that in ponds the sexes are often seen together among the long grass at the edge of the water; that there they seem to struggle; and that during this time they are in a state of suffering; they grow thin; they lose their appetite, and their flesh becomes flabby; the scales of some grow rough, and they lose their lustre. On the contrary, when the time of coupling is over, their appetite returns; they re-assume their natural agility, and their scales become brilliant and beautiful.

Although the usual way with spinous fishes is to produce by spawn; yet there are some, such as the eel and the blenny, that are known to bring forth their young alive. Bowlker, who has written a treatise upon fishing, seems to determine the question relative to the viviparous production of eels, upon the authority of one or two credible witnesses. An eel, opened in the presence of several persons of credit, was found to have an infinite number of little creatures, closely wrapped up together in a lump, about the size of a nutmeg, which being put into a basin of water, soon separated, and swam about: yet still, whether these may not have been worms generated in the animal's body, remains a doubt; for there are scarcely any fishes that are not infested with worms in that manner.[1]

With respect to the growth of fishes, it is observed, that among carps, particularly the first year, they grow to about the size of the leaf of a willow-tree; at two years, they are about four inches long. They grow but one inch more the third season, which is five inches. Those of four years old are about six inches; and seven after the fifth. From that to eight years old they are found to be large in proportion to the goodness of the pond, from eight to twelve inches. With regard to sea-fish, the fishermen assure us, that a fish must be six years old before it is fit to be served up to table. They instance it in the growth of a mackarel. They assure us that those of a year old are as large as one's finger; that those of two years, are about twice that length; at three and four years, they are that small kind of mackarel that have neither milts nor roes;

[1] The eel, it is known, is viviparous.

and between five and six, they are those full-grown fish that are served up to our tables. In the same manner, with regard to flat fishes, they tell us, that the turbot and barbel at one year are about the size of a crown-piece; the second year, as large as the palm of one's hand; and at the fifth and sixth year, they are large enough to be served up to table. Thus it appears, that fish are a considerable time in coming to their full growth, and that they are a long time destroyed before it comes to their turn to be destroyers.[1]

All fish live upon each other in some state of their existence. Those with the largest mouths attack and devour the larger kinds; those whose mouths are less, lie in wait for the smaller fry; and even these chiefly subsist upon spawn. Of those which live in the ocean, of the spinous kinds, the dorado is the most voracious. This is chiefly found in the tropical climates; and is at once the most active and the most beautiful of the finny region. It is about six feet long; the back all over enamelled with spots of a bluish green and silver; the tail and fins of a gold colour; and all have a brilliancy of tint, that nothing but nature's pencil can attain to; the eyes are placed on each side of the head, large and beautiful, surrounded with circles of shining gold. In the seas where they are found, these fish are always in motion, and play round ships in full sail with ease and security: for ever either pursuing or pursued, they are seen continually in a state of warfare; either defending themselves against the shark, or darting after the smaller fishes. Of all others, the Flying-fish most abounds in these seas; and as it is a small animal, seldom growing above the size of a herring, it is chiefly sought by the dorado. Nature has furnished each respectively with the powers of pursuit and evasion. The dorado being above six feet long, yet not thicker than a salmon, and furnished with a full compliment of fins, cuts its way through the water with amazing rapidity: on the other hand, the flying-fish is furnished with two pair of fins longer than the body, and these also moved by a stronger set of muscles than any other. This equality of power seems to furnish one of the most entertaining spectacles those seas can exhibit. The efforts to seize on the one side, and the arts of escaping on the other, are perfectly amusing. The dorado is seen, upon this occasion, darting after its prey, which will not leave the water, while it has the advantage of swimming, in the beginning of the chase. But, like a hunted hare, being tired at last, it then has recourse to another expedient for safety by flight. The long fins, which began to grow useless in the water, are now exerted in a different manner, and different direction, to that in which they were employed in swimming: by this means, the timid little animal rises from the water, and flutters over its surface for two or three hundred yards, till the muscles employed in moving the wings are enfeebled by that particular manner of exertion. By this time, however, they have acquired a fresh power of renewing their efforts in the water, and the animal is capable of proceeding with some velocity by swimming: still, however, the active enemy keeps it in view, and drives it again from the deep; till, at length, the poor little creature is seen to dart to shorter distances, to flutter with greater effort, and to drop down at last into the mouth of its fierce pursuer. But not the dorado alone, all animated nature seems combined against this little fish, which seems possessed of double powers, only to be subject to greater dangers. For though it should escape from its enemies of the deep, yet the tropic bird and the albatross are for ever upon the wing to seize it. Thus pursued in either element, it sometimes seeks refuge from a new enemy; and it is not unfrequent for whole shoals of them to fall on shipboard, where they furnish man with an object of useless curiosity.

The warfare in fresh water is not carried on with such destructive activity; nor are the inhabitants of that element so numerous. It would seem that there is something more favourable to the fecundity of fishes in the ocean than in an element less impregnated with salt. It has been the opinion of some philosophers that all fish are natives of that great reservoir; and that only colonies have been sent up rivers, either through accident, or the necessity of procuring subsistence. They have been led to this opinion by the superior fecundity of sea-fish, which breed twenty to one; as well as by their superiority in strength and size, over those of the same kind found in lakes and rivers. This is a matter too remotely speculative to be worth pursuing; but certain it is that, in fresh water, fishes seem to abate much of their courage and rapacity; pursue each other with less violence, and seem to be less powerfully actuated by all their appetites. The greediness with which sea-fish devour the bait is prodigious, if compared with the manner they take it in fresh water. The lines of such fishermen as go off to sea are coarse, thick, and clumsy, compared to what are used by those who fish at land. Their baits are seldom more than a piece of a fish, or the flesh of some quadruped, stuck on the hook in a bungling manner; and scarcely any art is employed to conceal the deception. But it is otherwise in fresh water:

[1] Traite des Peches, par Monsieur Duhamel. Sect. 3. p. 100.

the lines must often be drawn to a hair-like fineness; they must be tinctured of the peculiar colour of the stream; the bait must be formed with the nicest art, and even, if possible, to exceed the perfection of nature: yet still the fishes approach it with diffidence, and often swim round it with disdain. The cod, on the banks of Newfoundland, the instant the hook, which is only baited with the guts of the animal last taken, is dropped into the water, darts to it at once, and the fishermen have but to pull up as fast as they throw down. But it is otherwise with those who fish in fresh waters, they must wait whole hours in fruitless expectation; and *the patience of a fisherman* is proverbial among us.[1]

[1] *Fish usually taken by anglers in Great Britain.*—The *Barbel*, so called from its four barbs, two of which are at the corners of its mouth, and the others at the end of its snout, is a heavy, dull fish, and gives very inferior



sport to the angler, in proportion to his size and strength. They begin to shed their spawn about the middle of April, and come in season about a month or six weeks after. In their usual haunts, among weeds, &c., they are fond of rooting with their nose like the pig. In summer, they frequent the most powerful and rapid currents, and settle among logs of wood, piles, and weeds, where they remain for a long time apparently immovable; during the winter time, they return to deep bottoms. The most killing baits for the barbel are the spawn of trout, salmon, or indeed of any other fish, especially if it be fresh, respecting which, the barbel is very cunning; the paste that imitates it must, therefore, be well made, and of fresh flavour. It is also an advisable plan to bait the water over night, by spawn or a quantity of cut worms. The barbel will also bite well at the cobworm, gentles, and cheese, soaked in honey. The rod and line, with which you fish for barbel, must both be extremely long, with a running plummet attached to the latter, as they swim very close to the bottom. By a gentle inclination of the rod, you may easily ascertain when there is a bite; immediately upon which the fish should be struck, and seldom escapes, unless he break the line.

The *Bleak*, or *Blay*, is a common river fish, so called from its bleak or white appearance, that spawns in March; and is fond of many of the baits for trout. It is usually caught with a small artificial fly of a brown colour; and the hook should be suited in size to the fly. The bleak seldom exceeds six inches in length; its flesh is highly valued by epicures, and beads are made of its scales.

Bream (see it figured at page 297) shed their spawn about midsummer, and although they are occasionally met with in slow running rivers, are reckoned a pond fish, where they will thrive in the greatest perfection; and have been known to weigh from eight to ten lbs. In fishing for them, the angler should be very silent, and take all possible care to keep concealed from the fish, which are angled for near the bottom. His tackle also must be strong. This fish, according to Dr Shaw, is a native of many parts of Europe, inhabiting the still lakes and rivers, and sometimes found even in the Caspian sea.

This comparative neglect of food, which is found in all the tribes of fresh-water fishes, renders them less turbulent and less destructive among each other. Of all these the pike

Bull head, or *Miller's thumb*, is a small ugly fish, which hides itself in brooks and rivers under a gravelly bottom. They spawn in April, and their average length is from four to five inches. When their gill fins are cut off they serve as good baits for pike and trout, and, like the cray fish, when boiled, their flesh turns red.

Carp (see it described at page 305) is a fish that by its frequency of spawning, and quickness of growth, is greatly used to stock ponds, where it thrives better, and lives longer than in rivers. Gesner speaks of one who lived to 100 years old; there is much doubt about its general age, but it is supposed to be a very long lived fish. They spawn three or four times a year, but the earliest time is about the commencement of May. They are observed to live uncommonly long out of water, and in Holland are frequently kept alive for three weeks, or a month, in a cool place, by being hung with wet moss in a net, and fed with bread, steeped in milk. In angling for carp, it is necessary to make use of strong tackle, with a fine gut next the hook, and a float formed of the quill of a goose. They bite almost close to the bottom, and are rarely caught if angled for in a boat. From its subtlety, it has been sometimes called the water fox. The river carp is accustomed to haunt, in the winter, the most quiet and broad parts of the stream. In summer they live in deep holes, reaches, and nooks, under the roots of trees, and among great banks of weeds, until they are in a rotten condition. The pond carp loves a rich and fat soil, and will seldom or never thrive in cold, hungry waters. The carp ponds of Germany yield a considerable income to the gentry.

The *Chub*, (see it figured at page 307) or *Chevin*, is, like the perch, a very bold biter, and will rise eagerly at a natural or artificial fly. They spawn in June, or at the latter end of May, at which time they are easily caught by a fly, a beetle with its legs and wings cut off, or still more successfully by a large snail. When they are fished for at mid-water, or at bottom, a float should be made use of; when at top, it is customary to dip for them, or to use a fly, as if a trout were the angler's object. Strong tackle is also requisite, as they are a heavy fish, and usually require a landing net to pull them out. Their average length is from ten to fourteen inches.

Dace, *Dart*, or *Dare*, are a very active and cautious fish, and rise to a fly, either real or artificial. It is necessary, in angling for them, to remain in concealment as much as possible. They spawn in February and March, and their flesh is but inferior in point of flavour. They frequent gravelly, clayey, and sandy bottoms, leaves of the water lily, and deep holes, if well shaded. In sultry weather they are frequently caught in the shallows; and during that period, are best taken with grasshoppers or gentles. In fishing at bottom for roach and dace, who are similar in their haunts and disposition, bread soaked in water, and kneaded to a good consistency, and then made up together with bran into round balls, and thrown into the place where it is proposed to angle, will be found very serviceable, but must always be thrown up the stream. There is a mode of intoxicating dace, and by this means rendering them an easy prey; but this is no part of the real angler's sport. The Thames is well known to abound in dace, and the graining of the Mersey is thought to be a variety of the same species.

The *Eel* (see an account of eels at page 286) is rarely angled for, but it is usually caught by the process of sniggling or bobbing, with night lines, &c. Being fond of quiet in the day time, all who expect much sport in eel fishing must devote their evenings and even whole nights to the pursuit. The method for sniggling for eels

is the most active and voracious; and our poets, whose business it is to observe the surface of nature, have called it the tyrant of the watery plain. In fact, in proportion to its strength and celerity, the pike does some mischief; but what are its effects compared to those of the cachalot or the shark! they resemble the petty depredations of a robber, put in com-

is as follows :—Take a common needle, attached in the middle by fine waxed twine, a packthread line, or a strong small hook fixed to this kind of line; place a large lobworm, by the head end, on your needle or hook, and draw him on to his middle; affix another needle to the end of a long stick, and guide your bait with it into any of the known haunts of the fish, between mill boards, or into clefts of banks or holes, holding the line in your hand; now give the eel time to gorge the bait, and then by a sharp twitch fix the needle across his throat, or the hook into his body; tire him well, and your triumph is certain. Although this is not strictly a method of angling, the lovers of that sport will find it so successful a mode of diversifying their pursuits, where eels are common, that the present appeared the most convenient place to insert it. Bobbing is a rough species of angling. The best method is to provide yourself with a considerable number of good-sized worms, and string them from head to tail, by a needle, on fine strong twine, viz. to the amount of a pound, or a pound and a half in weight. Wind them round a card into a dozen or fifteen links, and secure the two ends of each link by threads. Now tie a strong cord to the bundle of strung worms, about a foot from which put on a bored plummet, and angle with a line from two to three feet long, attached to a stout tapering pole. Eels, and perhaps pike, are found in no part of Great Britain in such numbers or variety as in the marshy parts of the counties of Cambridge and Lincoln. The silver eel is the finest, and is very common in Scotland. The manner in which this fish is propagated, has long been a matter of dispute. They have neither spawn nor melt, as known organs of generation. Walton gravely argues for their being bred of corruption, "as some kind of bees and wasps are;" others strongly contend for their being viviparous. It is a subject, indeed, upon which naturalists have no certain information. The lamprey, (see it noticed at page 280) "a lambendo petras, from licking the rocks," says the quaint author of the Worthies of England, is a species of eel, variously esteemed. In Worcestershire and Gloucestershire, the Severn lamprey is regarded as a luxury; and, by the city of Gloucester, a pie made of this fish is annually presented to the queen. In the north of Great Britain it is much disliked. Eels bait in a shower, and in windy, gloomy weather, at the lob and garden worm, designed for other fish, particularly trout. Unlike other fish, they are never out of season. They are a very greedy fish, and if you wish to angle for them in the ordinary way, they will take a lamprey, wasp, grubs, minnows, &c., but particularly the first.

The *Pinnock*, or *Hirling*, is a species of sea trout which usually attains the length of from nine to fourteen inches, and is principally known in Scotland; the whitling, another species, is from sixteen to twenty-four inches long. They will both rise equally at an artificial fly, but require generally a more showy one than the common trout.

The *Grayling*, or *Umber*, (noticed at page 303) spawns in May, and is in the best condition in November. They will greedily take all the baits that a trout does, and frequent the same streams. They are said to have the fragrant smell of the plant Thymallus. Their average length is from sixteen to eighteen inches; and they must be angled for with very fine tackle, as they are a remarkably timid fish. When hooked, they must also be cautiously worked, as the hold in their mouth easily gives way; but they will speedily return to the bait. It is fine eating, unknown to Scotland or Ireland.

The *Gudgeon* (figured at page 295) is a fish in some request, both for its flavour and the sport it affords to the inexperienced angler. It is very simple, and is allured with almost any kind of bait. It spawns two or three times during the year; is generally from five to six inches long, and fond of gentle streams with a gravelly bottom. In angling for gudgeon, the bottom should be previously stirred up, as this rouses them from a state of inactivity, and collects them in shoals together. Some anglers use two or three hooks in gudgeon fishing. A float is always used, but the fish should not be struck on the first motion of it; as they are accustomed to nibble the bait before they swallow it. It frequently happens, that in angling for gudgeons, perch are caught.

The *Loach*, or *Groundling*, sheds its spawn in April, and remains in the gravel; where they are usually caught with a small red worm. They are principally found in the north of Great Britain, and in the streams of the mountainous parts. They are about three inches in length; and their flesh is pleasant and wholesome.

The *Minnow*, or *Minim*, one of the smallest river fish, seldom exceeds two inches in length. They spawn generally about once in two or three years, and swim together in shoals, in shallow waters, where they are very free, and bold in biting. They serve also as excellent baits for pike, trout, chub, perch, and many other fish, which prey upon and devour them greedily.

The *Mullet* takes almost the same baits as the trout, and will very eagerly rise to an artificial fly; they are considered free baiters, and come and go with the tide. If artificial flies are made use of, their size should be larger than those generally used to insnare the trout. They are found in their greatest perfection, in the river Arun, Sussex; but are seldom or never seen in Scotland.

The *Par*, or *Samlet*, (see it figured and described at page 302) is a fish that is known by different names in different parts of Great Britain. On the river Wye it is usually called a skirling; in Yorkshire, a brandling; in Northumberland, a rack-rider; and in some parts of England, a fingering, from the resemblance of its spotted streaks to the human fingers. Par, or Samlet, is its Scottish name, and in that part of Britain it is best known. Some have affirmed, that it is the blended spawn of the trout and salmon. This opinion is strengthened by the circumstances of their usually frequenting the same haunts with the salmon and sea trout, and their being forked in their tail like the former.

The *Perch* (see it noticed at page 298) is a very bold biting fish, and affords excellent amusement to the angler. He is distinguished by the beauty of his colours, and by a large erection on his back, strongly armed with stiff and sharp bristles, which he can raise or depress at pleasure. Defended by this natural excrescence, he bids defiance to the attacks of the ravenous and enormous pike, and will even dare to attack one of his own species. Perch spawn about the beginning of March, and measure from eight to fourteen inches. In fishing for perch with a minnow, or brandling, the hook should be run through the back fin of the bait, which must hang about six inches from the ground. A large cork float should be attached to the line, which should be leaded about nine inches from the hook. It must be observed, that they invariably refuse a fly.

The *Pike*, *Luce*, or *Jack*, (see it figured and described at page 303) is a fish of enormous size, and the greatest voracity; indeed, so notorious is he for the latter quality,

petition with the ravages of a conqueror! However, the pike will attack every fish less than itself; and it is sometimes seen choked, by attempting to swallow such as are too large a morsel. It is immaterial of what species the animal it pursues appears to be, whether of another or its own, all are indiscriminately devoured; so that every fish owes

as to have gained the appellation of the fresh water shark. They are also great breeders. Their usual time of shedding their spawn is about March, in extremely shallow waters. The finest pike are those which feed in clear rivers; those of fens or meres, being of very inferior quality. They grow to a vast size in these last mentioned places, where they feed principally on frogs, and such like nutriment. They are reckoned to be the most remarkable for longevity of all fresh water fish; are solitary and melancholy in their habits, generally swimming by themselves, and remaining alone in their haunts, until compelled by hunger to roam in quest of food. There are three modes of catching pike: by the ledger, the trolling, or walking bait, and the trimmer.

The *Pope*, or *Ruff*, is a fish very similar in its nature and appearance to the perch, and is frequently caught when fishing for the latter. They spawn in March and April, and are taken with a brandling, gentles, or caddis. They are extremely voracious in their disposition, and will devour a minnow, which is almost as big as themselves. In their favourite haunts of gentle deep streams, overhung by trees, they swim in shoals together; and you may fish for them either at the top or the bottom of the water, as they are known to bait in almost any weather, and in any situation. Their average length is from six to seven inches.

Roach are frequently taken with flies under water. They will bite at all the baits which are prepared for chub or dace, and are considered a simple and foolish fish. They spawn in May, and turn red when boiled. The compactness of their flesh gave rise to the proverb, "sound as a roach." The roach haunts shallow and gentle streams, and the mouths of small streams which run into larger ones. In angling for roach, the tackle must be strong, and the float large and well leaded.

The *Rud*, or *Finscale*, is a very scarce fish, found only in the river Charwell, in Oxfordshire, and a few of the lakes of Lincolnshire and Yorkshire. It sheds its spawn in April, will take all kinds of worms, and will rise at an artificial fly. Its colour is a kind of yellowish brown, and its average length from nine to fifteen inches.

Salmon (see page 301) are accustomed to quit the fresh waters, and retire into the sea at the approach of winter, which, at the commencement of April, they usually leave for rivers; but the Wye and Usk in Monmouthshire, and the Exe in Devonshire, have them in season during the six wintry months. The finest species are caught in the Exe, Thames, and Tamar, but not so abundantly as in many other places. Salmon prefer more chilly streams, and are consequently found in greater numbers northward, in the rivers of Scotland, particularly in the Tweed, the Tyne, the Clyde, and the Tay. In the latter, they occasionally occur at the immense weight of seventy pounds; and in the Tweed, and Clyde, at about fifty or sixty pounds weight. They are also found in all the great streams of Europe north of 51°, and in the United States of America north of 41°. Some recent accounts of the north-west coast of America, describe them also as abounding there. In the American rivers, they seldom exceed from fifteen to twenty pounds weight. They appear some time in the rivers before they are in a healthy state; and the best season for the angler to commence his operation, is in the close of the month of May, or the early part of June. The usual time for the salmon to deposit their spawn, is from the first of September to the latter end of October, when they grow very sickly both in appearance and flavour. Previous to this, they generally retire to brooks which branch out irregularly from the main river, or remain in shallows, where they sometimes are scarcely covered with water. During their residence in fresh water, it is a well authenticated circumstance, that they always lie with their heads pointing up the river; and never swim down the stream, unless during the period of their emigration to the sea, or when their position is molested. The length of the rod for catching salmon should be from about seventeen to twenty feet, which, however, can be regulated according to the breadth and general size of the river in which the angler pursues his operations. The reel, which on these occasions, forms the most material appendage to the rod, is made of brass; it should be constructed with the utmost nicety, and capable of the swiftest circumvolutions. The line, which is fastened to the reel, may be composed either of strong silk or twisted horse hair, gradually diminishing at the top, and having a loop at the end of the wheel, and another at the cast lines, to fasten them to each other. Let this last line be very carefully twisted with the fingers, and shorter than the rod, so that none of the knots may come within the top ring; sixteen to twenty horse hairs may be used in the upper links, but they must be diminished toward the hook, where they are best made of three small round twisted silk worm guts, or a few strong horse hairs. Of worms, lob-worms, earth-bobs, &c., and of fish, minnow have been used with great success. The artificial flies should be generally of large dimensions, and of a gaudy and glittering colour. The materials that compose them are hairs, furs, and wools, of every variety that can be collected, mingled with the tail-feathers of cocks and game, and secured together by plated wire, or gold and silver thread, marking silk, shoemakers' wax, bees' wax, &c. Their wings may be made of the feathers of domestic fowls, or any others of a showy colour. Imitate principally the natural flies; but you may safely indulge your fancy, rather than depart without a bite; for many anglers succeed with the most monstrous and capricious baits of this kind. A raw cockle, or muscle, taken out of the shell, prawns, and minnows, have also been recommended as salmon baits. The mode of angling with these is to drop the line, which must be totally unincumbered with shot, into some shallow which approximates to the edge of a hole of considerable depth, and in this situation to suffer it to be carried in by the current. The noviciate in angling will, at first, experience considerable difficulty in throwing his line to any great extent. For this we can give no recipe, but a most inflexible determination to proceed, and the most consummate patience in disappointment. It should always be thrown across the river, and on the off side from the spot where you expect the fish to rise. When you imagine that the salmon has been struck, be cautious in giving him time sufficient to enable him to poach his bait, that is, to swallow it fairly and securely. After this, fix the hook firmly in him, by a gentle twitch. On the first sensation of this pain, the salmon will plunge and spring with great violence, and use every endeavour of strength and cunning to effect his escape. He will then, perhaps, run away with a considerable length of line, which is to be kept in a gently relaxed situation, so that it may always yield with facility to his obstinate resistance: nor can you give him too much line, if you do but clear it of weeds and encumbrances. If he now become sullen and quiet in the water, rouse him gently, by flinging in a few stones; and when he once more commences resistance, do not be too eager in checking his career, but let him gradually exhaust himself of his

its safety to its minuteness, its celerity, or its courage: nor does the pike confine itself to feed on fish and frogs; it will draw down the water-rat and the young ducks, as they are swimming about. Gesner tells us of a mule that stooped to drink in the water, when a famished pike, that was near, seized it by the nose, nor was it disengaged till the beast flung it on shore. So great is their rapacity, that they will contend with the otter for his prey, and even endeavour to force it from him. For this reason it is dreaded by all other fish: and the small ones show the same uneasiness and detestation at the presence of their tyrant, as the little birds do at the sight of a hawk or an owl. When the pike lies asleep near the surface, as is frequently the case, the lesser fish are often observed to swim around it in vast numbers, with a mixture of caution and terror.

The other tribes of fresh-water fish are much inferior to this animal in courage and rapacity: they chiefly subsist upon worms and insects, pursuing them at the bottom, or jumping after them to the surface of the water. In winter also, their appetite seems entirely to forsake them; at least they continue in so torpid a state, that few baits will tempt them to their destruction. At that season, they forsake the shallow waters, and seek those deep holes to be found in every river, where they continue for days together, without ever appearing to move. The cold seems to affect them; for at that time they lie close to the bottom, where the water is most warm, and seldom venture out, except the day be peculiarly fine, and the shallows at the edges of the stream become tepified by the powerful rays of the sun. Indeed I have been assured, that some fishes may be rendered so torpid by the cold, in the northern rivers, as to be frozen up in the great masses of ice, in which they continue for several months together, seemingly without life or sensation, the prisoners of congelation, and waiting the approach of a warmer sun to restore them at once to life and

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strength; follow him down the stream, or allow him to cross it; while, at every, opportunity, you keep winding up your line until you approach him in this wearied state, and take him softly by the gills out of the water. The salmon peal may be caught in the same manner; he is smaller than the salmon, and seldom exceeds fourteen or fifteen inches in length.

Tench, (see page 306 for a figure of the Tench) like the carp, are generally considered pond fish, although they have been frequently caught in the river Stour. They shed their spawn about the commencement of July, and are in season from September to the latter end of May. They will bite very freely during the sultry months. Their haunts are similar to those of the carp; except that they frequent the foulest and muddiest bottoms, where they may shelter themselves among an infinite quantity of reeds; hence you must angle for them very near the bottom, and allow them sufficient time to gorge the bait.

Trout (see page 302) are considered as one of the finest river fish that this country can produce. Its colours are beautifully varied at different seasons of the year, and according to the rivers it frequents. They abound in the generality of our streams, rivers, and lakes, and are usually angled for with an artificial fly. Their weight also differs from half a pound to three; some few have been caught which weighed upwards of four pounds. Trout are extremely voracious; and, by their activity and eagerness, afford famous diversion to the angler. Previous to their spawning, they are observed to force a passage through weirs and flood-gates against the stream; and how they are enabled to overcome some of these impediments, is a subject of much conjecture. Their general time of shedding the spawn is about October or November; in some rivers, however, it is much sooner, in others later. They are also met with in eddies, where they remain concealed from observation behind a stone, or log, or a bank that projects into the stream; during the latter part of the summer, they are frequently caught in a mill-tail, and sometimes under the hollow of a bank, or the roots of a tree. In angling for trout, there are many things worthy of particular observation: 1st. That the day on which the sport is undertaken, be a little windy, or partially overcast, and the south wind is superior to all others, if it do not too much disturb your tackle. 2d. The sportsman should remain as far as possible from the stream, fish it downwards, the line never touching the water, as the agitation proceeding from the fall might disturb the fish, and preclude all possibility of capturing them. 3d. Clear streams are famous for sport, and in fishing in them, a small fly with slender wings must be attached to the hook. When the water is thick, and the sight more imperfect from this disadvantage, a larger species of bait must of necessity be used. 4th. The line should, on an average, be about twice as long as the rod, unless in cases of emergency, when the number and variety of trees exclude the probability of a successful throw, if at any distance. 5th. Let the fly be made to suit the season. After a shower, when the water becomes of a brown appearance, the most killing bait is the orange fly; in a clear day, the light coloured fly; and on a gloomy day, in overshadowed streams, a dark fly. Very large trout have been killed in Ullswater, in Cumberland, and still larger in Loch Awe in Argyleshire. Specimens of this great fish are to be found in Loch Awe, weighing from ten to twenty pounds. (See it figured and described at page 302.) It is said to be by far the most powerful of our fresh-water fishes, exceeding the salmon in actual strength, though not in activity. The most general size caught by trolling, ranges from three to fifteen pounds; beyond that weight they are of uncommon occurrence. If hooked upon tackle of moderate strength, they afford excellent sport; but the general method of fishing for them is almost as well adapted for catching sharks as trout; the angler being apparently more anxious to have it in his power to state that he had caught a fish of such a size, than to enjoy the pleasure of the sport itself. However, to the credit of both parties, it may be stated, that the very strongest tackle is sometimes snapped in two by its first tremendous springs. The ordinary method of fishing for this king of trouts is with a powerful rod, from a boat rowing at the rate of from three to four miles an hour; the lure, a common trout, from three to ten inches in length, baited upon six or eight salmon hooks, tied back to back upon strong gimp, assisted by two swivels, and the wheel-line strong whip cord. Yet all this, in the first impetuous efforts of the fish to regain its liberty, is frequently carried away for ever into the crystal depths of Loch Awe!

liberty. Thus that cheerful luminary not only distributes health and vegetation to the productions of the earth, but is ardently sought even by the gelid inhabitants of the water.

As fish are enemies one to another, so each species is infested with worms of different kinds peculiar to itself. The great fish abound with them; and the little ones are not entirely free. These troublesome vermin lodge themselves either in the jaws and the intestines internally, or near the fins without. When fish are healthy and fat they are not much annoyed by them; but in winter, when they are lean or sickly, they then suffer very much.

Nor does the reputed longevity of this class secure them from their peculiar disorders. They are not only affected by too much cold, but there are frequently certain dispositions of the element in which they reside unfavourable to their health and propagation. Some ponds they will not breed in, however artfully disposed for supplying them with fresh recruits of water, as well as provisions. In some seasons they are found to feel epidemic disorders, and are seen dead by the water side, without any apparent cause: yet still they are animals of all others the most vivacious, and they often live and subsist upon such substances as are poisonous to the more perfect classes of animated nature.

It is not easy to determine whether the poisonous qualities which many of them are found to possess, either when they wound our bodies externally with their spines, or when they are unwarily eaten at our tables, arises from this cause. That numbers of fishes inflict poisonous wounds, in the opinion of many, cannot be doubted. The concurrent testimony of mankind they think sufficient to contradict any reasonings upon this head, taken from anatomical inspection. The great pain that is felt from the sting given by the back fin of the weaver, bears no proportion to the smallness of the instrument that inflicts the wound. How the poison is preserved, or how it is conveyed by the animal, it is not in our power to perceive; but its actual existence has been often attested by painful experience. In this instance we must decline conjecture, satisfied with history.

The fact of their being poisonous when eaten, is equally notorious; and the cause equally inscrutable. My poor worthy friend, Dr Grainger, who resided for many years at St Christopher's, assured me, that of the fish caught, of the same kind, at one end of the island, some were the best and most wholesome in the world; while others taken at a different end were always dangerous, and most commonly fatal. We have a paper in the Philosophical Transactions, giving an account of the poisonous qualities of those found at New Providence, one of the Bahama islands. The author assures us, that the greatest part of the fish of that dreary coast are all of a deadly nature: their smallest effects being to bring on a terrible pain in the joints, which, if terminating favourably, leaves the patient without any appetite for several days after. It is not those of the most deformed figure, or the most frightful to look at, that are alone to be dreaded; all kinds, at different times, are alike dangerous; and the same species which has this day served for nourishment, is the next, if tried, found to be fatal!

This noxious quality has given rise to much speculation, and many conjectures. Some have supposed it to arise from the fishes on these shores eating of the manchineel apple, a deadly vegetable poison, that sometimes grows pendent over the sea; but the quantity of those trees growing in this manner, bears no proportion to the extensive infection of the fish. Labat has ascribed it to their eating the galley-fish, which is itself most potently poisonous: but this only removes our wonder a little farther back; for it may be asked, with as just a cause for curiosity, how comes the galley-fish itself to procure its noxious qualities? Others have ascribed the poison of these fishes to their feeding upon copperas-beds: but I do not know of any copper-mines found in America. In short, as we cannot describe the alembic by which the rattlesnake distils its malignity, nor the process by which the scorpion, that lives among roses, converts their sweets to venom, so we cannot discover the manner by which fishes become thus dangerous; and it is well for us of Europe that we can thus wonder in security. It is certain that with us, if fishes, such as carp or tench, acquire any disagreeable flavour from the lakes in which they have been bred, this can be removed, by their being kept some time in finer and better water: there they soon clear away all those disagreeable qualities their flesh had contracted, and become as delicate as if they had been always fed in the most cleanly manner. But this expedient is with us rather the precaution of luxury than the effect of fear: we have nothing to dread from the noxious qualities of our fish; for all the animals our waters furnish are wholesome.

Happy England! where the sea furnishes an abundant and luxurious repast, and the fresh waters an innocent and harmless pastime; where the angler, in cheerful solitude, strolls by the edge of the stream, and fears neither the coiled snake, nor the lurking crocodile; where he can retire at night, with his few trouts (to borrow the pretty description of old Walton) to some friendly cottage, where the

landlady is good, and the daughter innocent and beautiful; where the room is cleanly, with lavender in the sheets, and twenty ballads stuck about the wall! There he can enjoy the company of a talkative brother sportsman, have his trouts dressed for supper, tell tales, sing old tunes, or make a catch! There he can talk of the wonders of nature with learned admiration, or find some harmless sport to content him, and pass away a little time, without offence to God, or injury to man!

A

HISTORY OF FISHES.

BOOK IV.

OF CRUSTACEOUS AND TESTACEOUS FISHES.

CHAP. I.

THE DIVISION OF SHELL FISH.

In describing the inhabitants of the water, a class of animals occur, that mankind, from the place of their residence, have been content to call fish; but that naturalists, from their formation, have justly agreed to be unworthy of the name. Indeed the affinity many of this kind bear to the insect tribe, may very well plead for the historian who ranks them rather as insects. However, the common language of a country must not be slightly invaded; the names of things may remain, if the philosopher be careful to give precision to our ideas of them.

There are two classes of animals, therefore, inhabiting the water, which commonly receive the name of fishes, entirely different from those we have been describing, and also very distinct from each other. These are divided by naturalists into Crustaceous and Testaceous Animals; both, totally unlike fishes to appearance, seem to invert the order of nature; and as those have their bones on the inside, and their muscles hung upon them for the purposes of life and motion, these, on the contrary, have all their bony parts on the outside, and all their muscles within. Not to talk mysteriously—all who have seen a lobster or an oyster, perceive that the shell in these bears a strong analogy to the bones of other animals; and that, by these shells, the animal is sustained and defended.

Crustaceous fish, such as the crab and the lobster, have a shell not quite of a stony hardness, but rather resembling a firm crust, and in some measure capable of yielding.—Testaceous fishes, such as the oyster or cockle, are furnished with a shell of a stony hardness; very brittle, and incapable of yielding. Of the crustaceous kinds are the Lobster, the Crab, and the Tortoise: of the testaceous, that numerous tribe of Oysters, Mussels, Cockles, and Sea-Snails, which offer with infinite variety.

The crustaceous tribe[1] seems to hold the middle rank between fishes, properly so called, and those snail-like animals that receive the name of testaceous fishes. Their muscles are strong and firm, as in the former; their shell is self-produced, as among the latter. They have motion, and hunt for food with great avidity, like the former. They are incapable of swimming, but creep along the bottom, like the latter: in short, they form the link that unites these two classes, that seem so very opposite in their natures.

Of testaceous fishes we will speak hereafter. As to animals of the crustaceous kind, they are very numerous, their figure offers a hundred varieties: but as to their nature, they are obviously divided into two very distinct kinds, differing in their habits and their conformation.—The chief of one kind is the Lobster; the chief of the other, the Tortoise. Under the Lobster we rank the Prawn, the Cray-fish, the Shrimp, the Sea-Crab, the Land-Crab, and all their varieties. Under the Sea-Tortoise, the Turtle, the Hawksbill-Turtle, the Land-Tortoise, and their numerous varieties.

CHAP. II.

CRUSTACEOUS ANIMALS OF THE LOBSTER KIND.

However different in figure the lobster and the crab may seem, their manners and con-

[1] All the animals of this class are covered with inte-

formation are nearly the same. With all the voracious appetites of fishes, they are condemned to lead an insect life at the bottom of the water; and though pressed by continual hunger, they are often obliged to wait till accident brings them their prey. Though without any warmth in their bodies, or even without red blood circulating through their veins, they are animals wonderfully voracious. Whatever they seize upon that has life, is sure to perish, though never so well defended: they even devour each other; and to increase our surprise still more, they may, in some measure, be said to eat themselves; as they change their shell and their stomach every year, and their old stomach is generally the first morsel that serves to glut the new.

The *lobster* is an animal of so extraordinary a form, that those who first see it are apt to mistake the head for the tail; but it is soon



discovered that the animal moves with its claws foremost; and that the part which plays within itself by joints, like a coat of armour, is the tail. The two great claws are the lobster's instruments of provision and defence; these, by opening like a pair of nippers, have great strength, and take a firm hold; they are usually notched like a saw, which still more increases their tenacity. Beside these powerful instruments, which may be considered as arms, the lobster has eight legs, four on each side, and these, with the tail, serve to give the animal its progressive and sidling motion. Between the two claws is the animal's head, very small, and furnished with eyes that seem like two black horny specks on each side; and these it has a power of advancing out of the socket, and drawing in, at pleasure. The mouth, like that of insects, opens the long way of the body, not crossways, as with man, and the higher race of animals. It is furnished with two teeth for the comminution of its food; but, as these are not sufficient, it has three more in the stomach; one on each side, and the other below. Between the two teeth there is a fleshy substance, in the shape of a tongue. The intestines consist of one long bowel, which reaches from the mouth to the vent; but what this animal differs in from all others, is, that the spinal marrow is in the breast-bone. It is furnished with two long feelers or horns, that issue on each side of the head, that seem to correct the dimness of its sight, and apprize the animal of its danger, or of its prey. The tail, or that jointed instrument at the other end, is the grand instrument of motion; and with this it can raise itself in the water. Under this we usually see lodged the spawn in great abundance; every pea adhering to the next by a very fine filament, which is scarcely perceivable. Every lobster is an hermaphrodite and is supposed to be self-impregnated![1] The ovary, or place where the spawn is first produced, is backwards toward the tail, where a red substance is always found, and which is nothing but a cluster of peas, that are yet too small for exclusion. From this receptacle there go two canals, that open on each side at the jointures of the shell, at the belly; and through these passages the peas

guments of a crustaceous substance, more calcareous than that which envelopes the *myriapods*, the *arachnida*, and the *insects*. Most of them feed on bodies in a state of putrefaction, and in all the sexes are distinct.

[1] The animals of this tribe are by no means hermaphrodites, but are found distinctly male and female. The eggs are deposited under the tail of the females, which for that purpose is often much broader than that of the males. Amongst the numerous examples given by Dr Paley, of the wonderful manner in which Nature contrives to overcome difficulties, which would at first appear insurmountable, there is perhaps none more striking than the mode in which the lobster is released from his case when the increasing size of his body requires more room. In most animals the skin grows with their growth. In some animals, instead of a soft skin, there is a shell, which admits by its form of gradual enlargement. Thus the shell of the tortoise, which consists of several pieces, is gradually enlarged at the joinings of those pieces which are called "sutures." Shells with two sides, like those of the mussel, grow bigger by addition at the edge. Spiral shells, as those of the snail, receive this addition at their mouth. The simplicity of their form admits of this; but the lobster's shell being applied to the limbs of his body, as well as to the body itself, does not admit of either of the modes of enlargement which is observed in other shells. It is so hard that it cannot expand or stretch, and it is so complicated in its form that it does not admit of being enlarged by adding to its edge. How, then, was the growth of the lobster to be provided for? We have seen that room could not be made for him in his old shell: was he then to be annually fitted with a new one? If so, another difficulty arises: how was he to get out of his present confinement? How was he to open his hard coat, or draw his legs out of his boots which are become too tight for him? The works of the Deity are known by expedients, and the provisions of his power extend to the most desperate cases. The case of the lobster is thus provided for: At certain seasons his shell grows soft. The animal swells his body; the seams open, and the claws burst at the joints. When the shell is thus become loose upon the body, the animal makes a second effort, and by a trembling motion, a sort of spasm, casts off his case. In this state of nakedness the poor defenceless fish retires to a hole in the rocks. The released body makes a sudden growth. In about eight and forty hours a fresh concretion of humour takes place all over the surface of his body; it quickly hardens; and thus a new shell is formed, fitted in every part to the increased size of the body and limbs of the animal. See the subject fully handled by Mr Couch, in the following Note.

descend to be excluded, and placed under the tail, where the animal preserves them from danger for some time, until they come to maturity; when, being furnished with limbs and motion, they drop off into the water.

When the young lobsters leave the parent, they immediately seek for refuge in the smallest clefts of rocks, and in such like crevices at the bottom of the sea, where the entrance is but small, and the opening can be easily defended. There, without seeming to take any food, they grow larger in a few weeks' time, from the mere accidental substances which the water washes to their retreats. By this time, also, they acquire a hard firm shell, which furnishes them with both offensive and defensive armour. They then begin to issue from their fortresses, and boldly creep along the bottom, in hopes of meeting with more diminutive plunder. The spawn of fish, the smaller animals of their own kind, but chiefly the worms that keep at the bottom of the sea, supply them with plenty. They keep in this manner close among the rocks, busily employed in scratching up the sand with their claws for worms, or surprising such heedless animals as fall within their grasp: thus they have little to apprehend, except from each other; for in them, as among fishes, the large are the most formidable of all other enemies to the small.

But this life of abundance and security is soon to have a most dangerous interruption; for the body of the lobster still continuing to increase, while its shell remains unalterably the same, the animal becomes too large for its habitation, and, imprisoned within the crust that it has naturally gathered round it, there comes on a necessity of getting free. The young of this kind, therefore, that grow faster, as I am assured by the fishermen, change their shell oftener than the old, who come to their full growth, and who remain in the same shell often for two years together. In general however, all these animals change their shell once a-year; and this is not only a most painful operation, but also subjects them to every danger.[1] Moulting season is generally about the beginning of summer, at which time their food is in plenty, and their strength and vigour in the highest perfection. But soon all their activity ceases; they are seen forsaking the

[1] *Process of Exuviation in Shrimps, Lobsters, and Crabs.*—Dr Milne Edwards, in his Histoire Naturelle des Crustaces, has given an account of what may be considered the present state of our knowledge, of the circumstances under which the process of exuviation is effected, and the methods by which it is accomplished in the long-tailed stalk-eyed crustaceans; but as much of what that eminent naturalist advances is derived from other authorities, and I have reason to conclude, contrary to the general opinion, that the circumstances attending this process of nature, are different in even nearly allied species, there still remains space for inquiry.

Réaumur is our only original authority for the minute circumstances attending the process of exuviation, which he observed in the river crayfish (Potamobius fluviatilis, Leach,) but not having an opportunity of consulting that author's work, I copy his narrative from Dr M. Edwards's quotation: A few days previous to the commencement of the operations, the creature abstains from all solid nourishment, and the carapace and abdominal segments will be found to offer less than the usual resistance to the pressure of the finger. Shortly afterwards the crayfish appears restless, and rubs its legs against each other; it then throws itself on its back, agitates its whole body and then distends it, by which the membrane joining the carapace to the abdomen is burst, and this great dorsal plate is raised. Some degree of rest follows these first struggles; but after a short time the animal again puts all its organs in motion, the carapace is seen to rise gradually from the legs beneath, and in less than half an hour, the animal has extricated itself from this portion of its slough. By retracting its head, the antennæ, eyes, and legs are withdrawn as from a case; and the extrication of the last, being the most difficult and complicated operation, is attended with so much pain, that the effort sometimes occasions the loss of one or more of the organs. The hinder parts are withdrawn with less difficulty; the head is conducted below the carapace, and the tail being thrown off by a forward motion attended with a brisk and distensive action, the creature is seen divested of all its encumbrances, and the case is left unbroken, as if no struggle had ever taken place within it.

I have no doubt that the process here described in the cray-fish corresponds to what takes place in the common prawn (Palæmon serratus, Leach,) although I have never been able to observe it in operation:—the following is a description of the case from which the animal has recently extricated itself: The whole is thin, elastic and transparent; the carapace with its serrated process whole, the antennæ perfect to their minute extremities: the palpi and jaws drawn within the cavity of the thorax, and partially separated from the sternal plate; the latter with the legs still forming a loose attachment to each other, and without fracture, but drawn somewhat posteriorly into the thoracic cavity. The case and pedestal of one eye were within the thorax, but the other could not be found;—the legs perfect, and attached to the sternal plate. The caudal plates were united at their joints, but in no part was there any intervening membrane, this portion of the body not appearing to be thrown off with the more solid covering: a circumstance which will account for the fact, that the eyes do not long remain attached to the adjacent parts after the slough is left by its inhabitant.

The habits of the lobster (Astacus Europeus, Leach,) at this periodical crisis, and the circumstances attending it, present a very considerable difference from those of the species already mentioned. So far from abstaining from food, it is not uncommon for it to be taken in crab pots, which it has been enticed to enter by the allurement of the usual bait; and instances have been related to me, where, when the fishermen commenced to handle his capture, the animal has slipped away, leaving an empty husk as the only reward of his labour. It was by a circumstance somewhat similar that the opportunity is afforded me of giving a minute description of a very perfect case, left by the creature when it made its escape:—for escape it did, through an aperture too narrow to have allowed it to pass if its new covering had possessed a very moderate degree of firmness—to the no small annoyance of the fisherman, who had calculated on the possession of a prize somewhat above the ordinary magnitude. I cannot find that any extraordinary actions or contortions have been observed in the lobster, when

open parts of the deep, and seeking some retired situation among the rocks, or some outlet where they may remain in safety from the attacks of their various enemies. For some days before their change, the animal discontinues its usual voraciousness; it is no longer seen laboriously harrowing up the sand at the bottom, or fighting with others of its

engaged in delivering itself from its trammels, or that the time is prolonged, as is the case with the cray-fish; circumstances which are easily accounted for by an examination of the crust; and it is certain that when delivered it possesses great activity in effecting its escape, and that neither the prawn nor the lobster devour, as has been supposed, any portion of the old shell.

In the specimen referred to, the case of the antennæ and palpi was perfect to their minutest extremities; the stalk also, and transparent covering of the eyes, were uninjured, but the former was attached on its inferior portion only, the superior half hanging loose, so that it would soon have fallen away in the agitation of the sea. The segments and joints of the posterior portion of the body, with the caudal plates, were all joined together, but without any intervening membrane; and the inferior parts from beneath the snout, including the jaws and footjaws, chelædlegs, with the sternal plate, œsophagus and internal coat of the stomach, formed one connected portion, with no further separation than arises from the absence of every portion of membrane. The whole of these inferior portions was drawn very considerably within the carapace; and it was the latter section of the surface only that showed a mark of the manner in which the animal had delivered itself from its case; and this it did in a way not to be mistaken. Through the middle of this space, ran a line as straight as if it had been cut with a knife, and evidently formed by a natural process of separation: for it even proceeded through the centre of the snout, to the terminal pointed process, at the root of which it turned off on the right side; so that the least effort of the animal was sufficient to afford it a passage.

The observation here made on a very perfect specimen that came into my possession by great accident, has been further confirmed by a careful examination, both of the living lobster, in which an obscure line is perceptible, where the natural separation takes place: and also of a specimen of small size, in which the sloughing or natural process of division had only begun. In the latter case a deep channel had been formed on the external part, nearly half through the carapace; while the internal portion still remained firm; but I have little doubt that if the creature had lived but a few days longer, the separation would have been complete, and the animal would have escaped from its prison.

The growth of the young of the long-tailed Crustaceans, is well known to be exceedingly rapid; and there seems reason to believe that the process of exuviation is repeated at least two or three times in the course of the first year of their age. In the course of a summer, among many prawns one or two may always be found in a state that indicates the having lately passed through this process; but about October or November they all seem to undergo it at once, the breeding season finishes, and no further change in the shell takes place until the approach of the spring. It is not improbable that the general opinion is correct, which limits the exuviation of the adult animals to once in the year; but from the marks of old injuries, and the incrustation of parasitic animals, I have come to the conclusion that in advanced age the lobster does not throw off its case with any regularity, and perhaps not at all.

When about to throw off its exuviæ the crab commonly retires to some secret place, in the near neighbourhood of rocks that will afford it shelter when unable to escape from danger, or defend itself from enemies. Its craving appetite seems also at this time to be suspended; but the particular subject of my observation

differed from others, in wandering into a crab-pot at this period, in search of food; and being known by the fishermen to be what is called *peel*, that is, about to throw off its crust, it was transferred to the safe custody of the store-pot, on Saturday, July 30th, where, on the morning of August 1, it was found just then delivered from its covering. As quickly as possible, and without injury, the living crab and its empty representative were brought to me: and the following is a description of the exuviæ.

The longest diameter of the carapace was 6¾ inches; compass of the largest chela, and length of the flap or tail, severally 3¾ inches: the individual a female, or what is termed by fishermen a Bon Crab. The carapace was sound, except on its under surface, where in its ordinary state a curved line passes backward from the jaws to the hinder part of the body. When caught on the 30th this portion was observed by the fishermen to be loosened; and now the portion included between this waved line and the sternal plate, was entirely separate and fallen inward. The sheaths of the antennæ and palpi perfect; one eye gone, the other remaining, with the transparent covering perfect, the stalk loosely attached; the tail and all its appendages perfect; the sternal plate beginning to break across in the middle, leaving to each portion a pair of legs on each side; but this not being a complete or natural separation, may have been produced by the weight of the limbs alone, or the efforts of the animal. The chelæ and legs perfect in all their attachments, the membranes unbroken; and the flat bones which occupy the middle of the muscles and serve them for tendons or points of attachment for motion, were uninjured and fastened to each joint, their distant extremities hanging loosely in the cavity of the case of the limb. The coverings of the branchiæ were perfect to their minutest extremities; and besides the internal coat of the stomach, the whole internal skeleton of the animal was thrown off without fracture or displacement:—including the two motive bones or levers that pass through the middle of the body from the jaws, to be attached to the internal dorsal aspect of the carapace: where formerly attached, however, to the carapace they hung loose. The curious bony articulations of the grinding apparatus of the stomach, which renders the digestion of these Crustaceans analogous to the rumination of quadrupeds, together with the double crustaceous body (perhaps gland) at the pyloric orifice, and the whole of the bony crusts or chambers that receive the muscles which move the legs, were disengaged with displacement.

The living representative of this wonderful skeleton measured 7½ inches in its longest diameter, the compass of the largest chela, and length of the flap or tail, 4 inches; the weight 24½ ounces, being 5½ ounces less than an ordinary crab of the same dimensions, weighed with it for comparison. It was plump, having much the appearance of a lump of dough enclosed in a membrane; and it was also equally soft, with scarcely more power of motion: appearing sensitive only when pressed on the under surface of the carapace. The colour above was red, beneath a pale yellow, the flap purplish; the bristles on the legs fully formed, but soft, which is the more worthy of notice, as I have seen the Procellana platycheles, in which villosity forms a conspicuous character, entirely naked when just escaped from the crust. On cutting open the legs and chelæ, the bony plates to which the muscles are attached, and which serve for tendons, were found as soft as wet parchment, and towards the extreme joints, could not be distinguished with certainty. On breaking off the largest chela at the

kind, or hunting its prey; it lies torpid and motionless, as if in anxious expectation of the approaching change. Just before casting its shell, it throws itself upon its back, strikes its claws against each other, and every limb seems to tremble; its feelers are agitated, and the whole body is in violent motion; it then swells itself in an unusual manner, and at last the shell is seen beginning to divide at its junctures; particularly, it opens at the junctures of the belly, where, like a pair of jumps, it was before but seemingly united. It also seems turned inside out, and its stomach comes away with its shell.—After this, by the same operation, it disengages itself of the claws, which burst at the joints; the animal, with a tremulous motion, casting them off as a man would kick off a boot that was too big for him.

Thus, in a short time, this wonderful creature finds itself at liberty, but in so weak and enfeebled a state, that it continues for several hours motionless. Indeed, so violent and painful is the operation, that many of them die under it; and those which survive are in such a weakly state for some time, that they neither take food nor venture from their retreats. Immediately after this change, they have not only the softness but the timidity of a worm. Every animal of the deep is then a powerful enemy, which they can neither escape nor oppose; and this, in fact, is the time when the dog-fish, the cod, and the ray, devour them by hundreds. But this state of defenceless imbecility continues for a very short time: the animal, in less than two days, is seen to have the skin that covered its body grown almost as hard as before; its appetite is seen to increase; and, strange to behold! the first object that tempts its gluttony, is its own stomach, which it so lately was disengaged from. This it devours with great eagerness; and some time after eats even its former shell. In about forty-eight hours, in proportion to the animal's health and strength, the new shell is perfectly formed, and as hard as that which was but just thrown aside.

To contribute to the speedy growth of the shell, it is supposed by some, that the lobster is supplied with a very extraordinary concretion within its body, that is converted into the shelly substance. It is a chalky substance, found in the lower part of the stomach of all lobsters, improperly called crabs' eyes, and

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joint where the animal is itself accustomed to separate it when injured, the usual membrane formed towards the body, and no discharge took place; but a watery fluid proceeded copiously from the surface towards the limb, which was thus soon left empty, speedily becoming capable of being blown up with air like a bladder. On proceeding to dissect the body a similar circumstance took place, the fluid running off in so large a quantity, that I regretted when too late, that I had not taken the precaution to have measured it. In a few minutes, the body had so sunk into one mass that I was unable to distinguish the separate parts. At the lower and inner part of each joint of the chelæ and legs, an opening remained, in the form of a slit; through which the flat central bony plate, found in the empty crust, had been withdrawn; which opening of course must be closed when the shell is finally consolidated.

It appears from close inspection, that the exuviæ of a lobster consists of the same parts as those of a crab; the whole internal skeleton and external surface of the branchiæ, with the osseous tendons of the muscles, having been rejected. But they are more distinctly ascertained in the latter species, from their greater firmness of texture; and I may add also in reference to myself, that a desire to preserve the specimen perfect, had in the former case prevented a very minute examination of the internal structure.

Having procured a crab that was beginning to show signs of a commencement of the process of exuviation, I found the limbs shrunk to three-fourths of what the shell could well contain; the soft contents of the points of the chelæ being diminished much more than the muscular structure. A greater diminution than this, however, takes place before the process of deliverance is accomplished; but all the vigilance that I have exerted has not enabled me to see the actual escape from the crust; which is usually left in some void place, often in a sandy basin, and, as several fishermen have informed me, always on its back; as the living specimen I have described is represented also to have been found in the store-pot.

The newly extricated crab has at first strength enough to crawl off to a place of safety, commonly beneath the shelter of a neighbouring crevice, of such limited dimensions at its entrance, that it seems surprising it should ever be able to return from it, in its new state of growth. The first instinct of nature after securing a place of retreat, is to absorb, I suppose by swallowing it, as much fluid as will distend its organs and their common covering, now as flexible as velvet, to the full extent of their capacity; by which means the deposition of crustaceous particles is made according to the dimensions of its newly acquired bulk: which in the instance now described, that had arrived at the ordinary size of a female, and allowing for the thickness of the first crust, exceeded the former by at least an inch in its longest diameter, and in all its dimensions in the same proportion. In the early stages of growth, the increase of bulk at exuviation is, of course, much more considerable, in relative proportion. Some of these smaller specimens may be found passing through this natural process in every month of the year; but in some adult individuals, the same crust must continue for a long time, since I have seen one with oysters measuring two inches and a half in length, on the carapace; and in another, a mussel (mytilus) about an inch in length, attached by its byssus to a joint near the body.

Whether, as has been said, the rejected case forms a meal for its old inhabitant, on its first return to habits of activity, may well be questioned; though I have known an instance where one crab has devoured another, leaving nothing but the points of the legs, and a small portion of the carapace;—but in the analogous instance of a prawn, that had just thrown off its exuviæ, I have detected the source of the firmness of the new covering, in the presence of small shell-fish in its stomach. Under a lens, a minute trochus, perhaps the T. zizyphinus, and some specimens of an oval bivalve, were distinguishable. This is perhaps the only period of their lives when their food is of this kind, but its nature cannot often be ascertained, by the comminution it undergoes from the manner in which it is devoured, when the jaws have attained their firmness.—*From two communications by Mr Couch in the Magazine of Zoology and Botany.*

sold under that title in the shops. About the time the lobster quits its shell, the teeth in its stomach break these stones to pieces, and the fluids contained therein dissolve them. This fluid, which still remains in the new stomach, is thought to be replete with a petrifying quality, proper for forming a new shell: however, the concreting power that first formed these, shows a sufficient power in the animal to produce also the shell; and it is going but a short way in the causes of things when we attempt to explain one wonder by another.

When the lobster is completely equipped in its new shell, it then appears how much it has grown in the space of a few days; the dimensions of the old shell being compared with those of the new, it will be found that the creature is increased above a third in its size; and, like a boy that has outgrown his clothes, it seems wonderful how the deserted shell was able to contain so great an animal as entirely fills up the new.

The creature thus furnished, not only with a complete covering, but also a greater share of strength and courage, ventures more boldly among the animals of the bottom; and not a week passes, that, in its combats, it does not suffer some mutilation. A joint, or even a whole claw, is sometimes snapped off in these encounters. At certain seasons of the year these animals never meet each other without an engagement. In these, to come off with the loss of a leg, or even a claw, is considered as no great calamity; the victor carries off the spoil to feast upon at leisure, while the other retires from the defeat to wait for a thorough repair. This repair it is not long in procuring. From the place where the joint of the claw was cut away, is seen in a most surprising manner to burgeon out the beginning of a new claw. This, if observed at first, is small and tender, but grows, in the space of three weeks, to be almost as large and as powerful as the old one. I say almost as large, for it never arrives to the full size; and this is the reason we generally find the claws of lobsters of unequal magnitude.[1]

After what has been thus described, let us pause a little, to reflect on the wonders this extraordinary creature offers to our imagination! An animal without bones on the inside, yet furnished with a stomach capable of digesting the hardest substances, the shells of muscels, of oysters, and even its own; an animal gaining a new stomach and a new shell at stated intervals! furnished with the instruments of generation double in both sexes; and yet with an apparent incapacity of uniting! without red blood circulating through the body, and yet apparently vigorous and active! but, most strange of all, an animal endowed with a vital principle that furnishes out such limbs as have been cut away; and keeps continually combating it, though in constant repair to renew its engagements! These are but a small part of the wonders of the deep, where nature sports without a spectator!

Of this extraordinary yet well-known animal there are many varieties, with some differences in the claws, but little in the habits or conformation.[2] It is found above three feet long; and if we may admit the shrimp and the prawn into the class, though unfurnished with claws, it is seen not above an inch. These all live in the water, and can bear its absence for but a few hours. The shell is black when taken out of the water, but turns red by boiling. The most common way of taking the lobster is in a basket, or pot, as the fishermen call it, made of wicker-work, in which they put the bait, and then throw it to the bottom of the sea, in six or ten fathom water. The lobsters creep into this for the sake of the bait, but are not able to get out again. The river cray-fish[3] differs little from

[1] In the water, these animals are able to run nimbly upon their legs or small claws; and, if alarmed, they can spring, tail foremost, to a surprising distance almost as swiftly as a bird can fly.

[2] The *Norway Lobster*.—It has generally eight legs, besides two claspers, with six unequal feelers; two eyes, commonly distant, placed on fast stakes, and movable; the tail is articulated and unarmed. The body is long, with the thorax aculeated forwards; and prismatic arms, with the angles spiny. This species is nearly equal in size to the common lobster, and is principally found in the northern ocean. It also inhabits Great Britain.

The *Prawn*.—Prawns have a long serrated snout, bending upwards; three pair of very long filiform feelers; claws small, furnished with two fangs; smooth thorax; five joints to the tail; middle caudal fin subulated, two outmost flat and rounded. It is frequent in several shores among loose stones; sometimes found at sea, and taken on the surface over thirty fathoms depth of water: cinereous when fresh, and of a fine red when boiled.

The *Shrimp*.—Shrimps possess long slender feelers, and between them two projective laminæ; the claws have a single-hooked movable fang; they have three pair of legs; seven joints in the tail; the middle caudal fin subulated, the four others round and fringed; a spine on the exterior side of each of the outmost. These animals inhabit the shores of Britain in vast quantities, and are the most delicious of the genus.

The *Squilla*.—This has a snout like a prawn, but deeper and thinner; the feelers longer in proportion to the bulk; the sub-caudal fins rather larger. This animal is, at full growth, not above the bulk of the shrimp. The squilla inhabits the coast of Kent, and is sold in London under the name of the white shrimp, as it assumes that colour when boiled.

[3] *Cray* or *Craw fish*.—This species of lobster has a projecting snout, slightly serrated on the sides; a smooth thorax; the back smooth, with two small spines on each side; the claws large, beset with small tubercles; the two first pair of legs clawed, the two next subulated; the tail consists of five joints; and the caudal fins are rounded. The flesh of the craw-fish is cooling, moistening, and adapted to nourish such as labour under con-

the lobster, but that the one will live only in fresh water, and the other will thrive only in the sea.

The *crab* is an animal found equally in fresh and salt water; as well upon land as in the ocean. In shape it differs very much from



the lobster, but entirely resembles it in habits and conformation. The tail in this animal is not so apparent as in the former, being that broad flap that seems to cover a part of the belly, and when lifted discovers the peas or spawn, situated there in great abundance. It resembles the lobster in the number of its claws, which are two; and its legs, which are eight, four on either side. Like the lobster, it is a bold voracious animal; and such an enmity do crabs bear each other, that those who carry them for sale to market, often tie their claws with strings to prevent their fighting and maiming themselves by the way. In short, it resembles the lobster in every thing but the amazing bulk of its body compared to the size of its head, and the length of its intestines, which have many convolutions.

As the crab, however, is found upon land as well as in water, the peculiarity of its situation produces a difference in its habitudes, which it is proper to describe. The Land Crab is found in some of the warmer regions of Europe, and in great abundance in all the tropical climates in Africa and America. They are of various kinds, and endued with

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sumptions. Though they are variously dressed, yet no parts of them are eatable except their claws and tails. Soups are frequently made of them.

There are great quantities of these fish in the river Obra, on the borders of Silesia; but the people find them scarcely eatable, because of a bitter aromatic flavour, very disagreeable in food. Craw-fish also abound in the river Don, in Muscovy, where they are laid in heaps to putrefy, after which the stones called crab's eyes are picked out. These animals are very greedy of flesh, and flock in great numbers about carcases thrown in the water where they are, and never leave them while any remains: they also feed on dead frogs when they come in their way. In Switzerland there are some craw-fish which are red when they are alive, and others bluish. Some kinds of them also will never become red, even by boiling, but continue blackish.

Craw-fish are found in many of our rivers lodged in holes which they form in the clayey banks; and their presence is generally esteemed an evidence of the goodness of the water. They are frequently taken by means of sticks, split at the end, with a bait inserted in the cleft, and stuck in the mud at the distance of a few feet from each other. These sticks, after remaining some time, are taken up, generally with an animal adhering to each. They are gently drawn out of the mud, and a basket is put under them, to receive the animals which always drop off when brought to the surface of the water.

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[2] Who would expect an animal so low in the scale of creation as a *crab*, to be furnished with ten or twelve pair of jaws to its mouth? Yet such is the fact; and all these variously constructed pieces are provided with appropriate muscles, and move in a manner which can scarcely be explained, though it may be very readily comprehended when once observed in living nature. But after all the complexity of the jaws, where would an inexperienced person look for their teeth? surely not in the stomach? Nevertheless, such is their situation; and these are not mere appendages, that are called teeth by courtesy, but stout regular grinding teeth, with a light brown surface. They are not only within the stomach, but fixed to a cartilage nearest to its lower extremity, so that the food, unlike that of other creatures, is submitted to the action of the teeth as it is passing *from* the stomach, instead of being chewed before it is swallowed. In some species the teeth are five in number; but throughout this class of animals the same general principle of construction may be observed. Crabs and their kindred have no brain, because they are not required to reason upon what they observe; they have a nervous system excellently suited to their mode of life, and its knots or ganglia send out nerves to the organs of sense, digestion, motion, &c. The senses of these beings are very acute, especially their sight, hearing, and smell. Most of my readers have heard of crab's eyes, or have seen these organs in the animal on the end of two little projecting knobs, above and on each side of the mouth; few of them, however, have seen the crab's ear; yet it is very easily found, and is a little triangular bump placed near the base of the feelers. This bump has a membrane stretched over it, and communicates with a small cavity, which is the internal ear. The *organ* of smell is not so easily demonstrated as that of hearing, though the evidence of their possessing the sense to an acute degree is readily attainable.

The greater proportion of the genera feed on animal matter, especially after decomposition has begun; a large number are exclusively confined to the deep waters, and approach the shoals and lands only during the spawning season. Many live in the sea, but daily pass many hours upon the rocky shores for the pleasure of basking in the sun; others live in marshy or moist ground, at a considerable distance from the water, and feed principally on vegetable food, especially the sugar cane, of which they are extremely destructive. Others again reside habitually on the hills or mountains, and visit the sea only once a year, for the purpose of depositing their eggs in the sand. All those which reside in burrows made in moist ground, and those coming daily on the rocks to bask in the sun, participate in about an equal degree in the qualities of vigilance and swiftness. Many a breathless race have I run in vain, attempting to intercept them, and prevent their escaping into the sea. Many an hour of cautious and solicitous endeavour to steal upon them unobserved, has been frustrated by their long-sighted watchfulness; and several times, when, by extreme care and cunning approaches, I have actually succeeded in getting between a fine specimen and the sea, and had full hope of driving them farther inland, have all my anticipations been ruined by the wonderful swiftness of their flight, or the surprising facility with which they would dart off in the very opposite direction, at the very moment I felt almost sure of my prize.

The fleet-running crab (*Cypoda pugilator*), mentioned as living in burrows dug in a moist soil, and preying chiefly on the sugar cane, is justly regarded as one of the

various properties; some being healthful, delicious, and nourishing food; others, poisonous or malignant to the last degree; some are not above half an inch broad, others are found a foot over; some are of a dirty brown, and others beautifully mottled. That animal called the Violet Crab of the Caribbee islands, is the most noted, both for its shape, the deli-

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most noxious pests that can infest a plantation. Their burrows extend to a great depth, and run in various directions; they are also, like those of our fiddlers, nearly full of muddy water; so that, when these marauders once plump into their dens, they must be considered as entirely beyond pursuit. They are so numerous, and they multiply in such numbers, as in some seasons to destroy a large proportion of a sugar crop, and sometimes their ravages, combined with those of the rats and other plunderers, are absolutely ruinous to the sea-side planters. I was shown, by the superintendent of a place thus infested, a great quantity of cane utterly killed by these creatures, which cut it off in a peculiar manner, in order to suck the juice; and he assured me that, during that season, the crop would be two-thirds less than its average, solely owing to the inroads of the crabs and rats, which, if possible, are still more numerous. It was to me an irresistible source of amusement to observe the air of spite and vexation with which he spoke of the crabs; the rats he could shoot, poison, or drive off for a time with dogs. But the crabs would not eat his poison while sugar cane was growing; the dogs could only chase them into their holes; and if, in helpless irritation, he sometimes fired his gun at a cluster of them, the shot only rattled over their shells like hail against a window. It is truly desirable that some summary mode of lessening their number could be devised, and it is probable that this will be best effected by poison, as it may be possible to obtain a bait sufficiently attractive to ensnare them. Species of this genus are found in various parts of our country, more especially towards the south. About Cape May, our friends may have excellent opportunities of testing the truth of what is said of their swiftness and vigilance.

The *land crab*, which is common to many of the West India islands, is more generally known as the *Jamaica crab*, because it has been most frequently described from observation in that island. Wherever found, they have all the habit of living, during great part of the year, in the highlands, where they pass the daytime concealed in huts, cavities, and under stones, and come out at night for their food. They are remarkable for collecting in vast bodies, and marching annually to the sea-side, in order to deposit their eggs in the sand; and this accomplished, they return to their former abodes, if undisturbed. They commence their march in the night, and move in the most direct line towards the destined point. So obstinately do they pursue this route, that they will not turn out of it for any obstacle that can possibly be surmounted. During the daytime, they skulk and lie hid as closely as possible, but thousands upon thousands of them are taken for the use of the table by whites and blacks, as on their seaward march they are very fat and of fine flavour. On the homeward journey, those that have escaped capture are weak, exhausted, and unfit for use. Before dismissing the crabs, I must mention one which was a source of much annoyance to me at first, and of considerable interest afterwards, from the observation of its habits. At that time I resided in a house situated about two hundred yards from the sea, fronting the setting sun, having in clear weather the lofty mountains of Porto Rico in view, distant about eighty miles. Like most of the houses in the island, ours had seen better days, as was evident from various breaks in the floors, angles rotted off the doors, sunken sills, and other indications of decay. Our sleeping room, which was on the lower floor, was especially in this condition; but as the weather was delightfully warm, a few cracks and openings, though rather large, did not threaten much inconvenience. Our bed was provided with that indispensable accompaniment, a mosquito bar or curtain, to which we were indebted for escape from various annoyances. Scarcely had we extinguished the light, and composed ourselves to rest, than we heard, in various parts of the room, the most startling noises. It appeared as if numerous hard and heavy bodies were trailed along the floor; they then sounded as if climbing up the chairs and other furniture, and frequently something like a large stone would tumble down from such elevations with a loud noise, followed by a peculiar chirping noise. What an effect this produced upon entirely inexperienced strangers, may well be imagined by those who have been suddenly waked up in the dark, by some unaccountable noise in the room. Finally, these invaders began to ascend the bed; but happily the musquito bar was securely tucked under the bed all around, and they were denied access, though their efforts and tumbles to the floor produced no very comfortable reflections. Towards daylight they began to retire, and in the morning no trace of any such visitants could be perceived. On mentioning our troubles, we were told that this nocturnal disturber was only Bernard the Hermit, called generally the soldier crab, perhaps from the peculiar habit he has of protecting his body by thrusting it into an empty shell, which he afterwards carries about, until he outgrows it, when it is relinquished for a larger. Not choosing to pass another night quite so noisily, due care was taken to exclude Monsieur Bernard, whose knockings were thenceforward confined to the outside of the house. I baited a large wire rat-trap with some corn meal, and placed it outside of the back door, and in the morning found it literally half filled with these crabs, from the largest sized shell that could enter the trap, down to such as were not larger than a hickory nut. Here was a fine collection made at once, affording a very considerable variety in the size and age of the specimens, and the different shells into which they had introduced themselves.

The *soldier*, or *hermit* crab, when withdrawn from his adopted shell, presents about the head and claws a considerable family resemblance to the lobster. The claws, however, are very short and broad, and the body covered with hard shell only in that part which is liable to be exposed or protruded. The posterior or abdominal part of the body is covered only by a tough skin, and tapers towards a small extremity, furnished with a sort of hook-like apparatus, enabling it to hold on to its factitious dwelling. Along the surface of its abdomen, as well as on the back, there are small projections, apparently intended for the same purpose. When once fairly in possession of a shell, it would be quite a difficult matter to pull the crab out, though a very little heat applied to the shell will quickly induce him to leave it. The shells they select are taken solely with reference to their suitableness, and hence you may catch a considerable number of the same species, each of which is in a different species or genus of shell. The shells commonly used by them, when of larger size, are those of the whilk, which are much used as an article of food by the islanders, or the smaller conch (strombus) shells. The very young hermit crabs are found in almost every variety of small shell found on the shores of the Antilles. I have frequently been amused by ladies eagerly engaged in making collections of these beautiful little shells, and not dreaming of their being tenanted by a living animal, suddenly startled, on displaying their acquisitions, by observing

cacy of its flesh and the singularity of its manners.

The Violet Crab somewhat resembles two hands cut through the middle and joined together; for each side looks like four fingers, and the two nippers or claws resemble the thumbs. All the rest of the body is covered with a shell as large as a man's hand, and bunched in the middle, on the fore part of which there are two long eyes of the size of a grain of barley, as transparent as crystal, and as hard as horn. A little below these is the mouth, covered with a sort of barbs, under which there are two broad sharp teeth as white as snow. They are not placed, as in other animals, crossways, but in the opposite direction, not much unlike the blades of a pair of scissars. With these teeth they can easily cut leaves, fruits, and rotten wood, which is their usual food. But their principal instrument for cutting and seizing their food is their nippers, which catch such a hold, that the animal loses the limb sooner than its grasp, and is often seen scampering off, having left its claw still holding fast upon the enemy. The faithful claw seems to perform its duty, and keeps for above a minute fastened upon the finger while the crab is making off. In fact, it loses no great matter by leaving a leg or an arm, for they soon grow again, and the animal is found as perfect as before.[1]

This, however, is the least surprising part of this creature's history; and what I am going to relate, were it not as well known and as confidently confirmed as any other circumstance in natural history, it might well stagger our belief. These animals live not only in a kind of orderly society in their retreats in the mountains, but regularly once a year march down to the sea-side in a body of some millions at a time. As they multiply in great numbers, they choose the months of April or May to begin their expedition; and then sally out by thousands from the stumps of hollow trees, from the clefts of the rocks, and from the holes which they dig for themselves under the surface of the earth. At that time the whole ground is covered with this band of adventurers; there is no setting down one's foot without treading upon them.[2] The sea is their place of destination, and to that they direct their march with right-lined precision. No geometrician could send them to their destined station by a shorter course; they neither turn to the right or left, whatever obstacles intervene; and even if they meet with a house, they will attempt to scale the walls to keep the unbroken tenor of their way. But though this be the general order of their rout, they upon other occasions are compelled to conform to the face of the country; and if it be intersected by rivers, they are then seen to wind along the course of the stream. The procession sets forward from the mountains with the regularity of an army, under the guidance of an experienced commander. They are commonly divided into three battalions; of which the first consists of the strongest and boldest males, that, like pioneers, march forward to clear the route, and face the greatest dangers. These are often obliged to halt for want of rain, and go into the most convenient encampment till the weather changes. The main body of the army is composed of females, which never leave the mountains till the rain is set in for some time, and then descend in regular battalia, being formed into columns of fifty paces broad and three miles deep, and so close that they almost cover the ground. Three or four days after this the rear-guard follows; a straggling undisciplined tribe consisting of males and females, but neither so robust nor so numerous as the former. The night is their chief time of proceeding; but if it rains by day, they do not fail to profit by the occasion; and they

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them to be actively endeavouring to escape; or on introducing the hand into the reticule to produce a particular fine specimen, to receive a smart pinch from the claws of the little hermit. The aquatic soldiers may be seen towing along shells of most disproportionate size; but their relatives, who travel over the hills by moonlight, know that all unnecessary encumbrance of weight should be avoided. They are as pugnacious and spiteful as any of the crustaceous class; and when taken, or when they fall and jar themselves considerably, utter a chirping noise, which is evidently an angry expression. They are ever ready to bite with their claws, and the pinch of the larger individuals is quite painful. It is said that when they are changing their shells for the sake of obtaining more commodious coverings, they frequently fight for possession, which may be true where two that have forsaken their old shells meet, or happen to make choice of the same vacant one.—*Rambles of a Naturalist, by John D. Godman, M. D. United States.*

[1] The skeleton of the crab is external. Each side is provided with four legs and a hand. The latter is divided at the extremity into two parts, resembling the notched jaws of a pair of pincers. One of these parts is movable and the other is not. The feet are furnished with bristles. The senses of the crab are not deficient in acuteness. The sense of smell is not wanting, though it is not yet known where that organ is seated. The powers of vision are lively, and are the result of a complex structure, while the organ of hearing, placed near the base of the antennæ, is doubtless in every respect adapted to its necessities. It is generally difficult to surprise land-crabs; their acuteness of sight or hearing, or perhaps both, being soon alarmed. The antennæ are the organs of touch. The crab has no tongue, but possesses the organ of taste. It is a voracious feeder, and not very delicate in its choice. The mouth is furnished with eight pieces or pairs of jaws; and grinding teeth are attached to a cartilaginous appendage in the stomach, where the process of mastication is completed. Hence the crab is said to be a ruminating animal. The liver is very large, and is considered by epicures as a delicious morsel. The blood is either colourless or has a slight blue tinge.

[2] Labat. Voyage aux Isle Françoises, vol. ii. p. 221.

continue to move forward in their slow uniform manner. When the sun shines and is hot upon the surface of the ground, they then make a universal halt, and wait till the cool of the evening. When they are terrified, they march back in a confused disorderly manner, holding up their nippers, with which they sometimes tear off a piece of the skin, and then leave the weapon where they inflicted the wound. They even try to intimidate their enemies; for they often clatter their nippers together, as if it were to threaten those that come to disturb them. But though they must strive to be formidable to man, they are much more so to each other; for they are possessed of one most unsocial property, which is, that if any of them by accident is maimed in such a manner as to be incapable of proceeding, the rest fall upon and devour it on the spot, and then pursue their journey.

When after a fatiguing march, and escaping a thousand dangers, (for they are sometimes three months in getting to the shore,) they have arrived at their destined port, they prepare to cast their spawn. The peas are as yet within their bodies, and not excluded, as is usual in animals of this kind, under the tail; for the creature waits for the benefit of the sea-water to help the delivery. For this purpose, the crab has no sooner reached the shore, than it eagerly goes to the edge of the water, and lets the waves wash over its body two or three times. This seems only a preparation for bringing their spawn to maturity; for without farther delay they withdraw to seek a lodging upon land: in the mean time the spawn grows larger, is excluded out of the body, and sticks to the barbs under the flap, or more properly the tail. This bunch is seen as big as a hen's egg, and exactly resembling the roes of herrings. In this state of pregnancy, they once more seek the shore for the last time, and shaking off their spawn into the water, leave accident to bring it to maturity. At this time whole shoals of hungry fish are at the shore, in expectation of this annual supply; the sea to a great distance seems black with them; and about two-thirds of the crabs' eggs are immediately devoured by those rapacious invaders. The eggs that escape are hatched under the sand; and soon after millions at a time of these little crabs are seen quitting the shore, and slowly travelling up to the mountains.

The old ones, however, are not so active to return; they have become so feeble and lean, that they can hardly creep along, and the flesh at that time changes its colour. The most of them, therefore, are obliged to continue in the flat parts of the country till they recover, making holes in the earth, which they cover at the mouth with leaves and dirt, so that no air may enter. There they throw off their old shells, which they leave as it were quite whole, the place where they opened on the belly being unseen. At that time they are quite naked, and almost without motion for six days together, when they become so fat as to be delicious food. They have then under their stomachs four large white stones, which gradually decrease in proportion as the shell hardens, and when they come to perfection are not to be found. It is at that time that the animal is seen slowly making its way back; and all this is most commonly performed in the space of six weeks.

This animal, when possessed of its retreats in the mountains, is impregnable; for only subsisting upon vegetables, it seldom ventures out; and its habitation being in the most inaccessible places, it remains for a great part of the season in perfect security. It is only when impelled by the desire of bringing forth its young, and when compelled to descend into the flat country, that it is taken. At that time the natives wait for its descent in eager expectation, and destroy thousands: but disregarding the bodies, they only seek for that small spawn which lies on each side of the stomach within the shell; of about the thickness of a man's thumb. They are much more valuable upon their return, after they have cast their shell; for being covered with a skin resembling soft parchment, almost every part except their stomach may be eaten. They are taken in their holes by feeling for them in the ground with an instrument: they are sought after by night, when on their journey, with flambeaux. The instant the animal perceives itself attacked, it throws itself on its back, and with its claws pinches most terribly whatever it happens to fasten on. But the dexterous crab-catcher takes them by the hinder legs in such a manner, that its nippers cannot touch him, and thus he throws it into his bag. Sometimes also they are caught when they take refuge at the bottom of holes, in rocks by the sea-side, by clapping a stick at the mouth of the hole, which prevents their getting out; and then soon after the tide coming, enters the hole, and the animal is found, upon its retiring, drowned in its retreat. [1]

[1] There are various modes of taking crabs—some extremely simple, and others on a larger and more complex scale for commercial purposes. In the West Indies the monkeys adopt an ingenious expedient for catching crabs. They insert their tails in the holes where the crabs take refuge, and the crab fastening upon it, the monkey withdraws his tail with a jerk, and then conveys his prey on shore. By what expedient the crab is induced to release its hold we are not informed, but this must be no easy matter, as it grasps whatever it seizes in its claws with remarkable tenacity. Several species of birds, which occasionally live on shell-fish, obtain the meat out of the shell by dropping the shell from a considerable height;

These crabs are of considerable advantage to the natives; and the slaves very often feed entirely upon them. In Jamaica, where they are found in great plenty, they are considered as one of the greatest delicacies of the place. Yet still, the eating of them is attended with some danger; for even of this kind many are found poisonous, being fed, as it is thought, upon the manchineel apple; and whenever they are found under that noxious plant, they are always rejected with caution. It is thus with almost all the productions of those luxurious climates; however tempting they may be to the appetite, they but too often are found destructive; and scarce a delicacy among them that does not carry its own alloy.

The descent of these creatures for such important purposes, deserves our admiration; but there is an animal of the lobster kind that annually descends from its mountains in like manner, and for purposes still more important and various. Its descent is not only to produce

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and the monkeys are probably not less ingenious in their devices. Brickell gives an interesting account, in his *History of North Carolina* of the wonderful cunning manifested by the racoon in that country. It is fond of crabs, and, when in quest of them, will take its station by a swamp, and hang its tail over into the water, which the crabs mistake for food, and lay hold of it; as soon as the racoon feels them pinch, he pulls up his tail with a sudden jerk, and they generally quit their hold upon being removed from the water. The racoon instantly seizes the crabs in his mouth, removes them to a distance from the water, and greedily devours his prey. He is very careful how he takes them up, which he always does from behind, holding them transversely, in order to prevent them catching his mouth with their nippers. The children of fishermen are often employed in crab-catching, as crabs are found on a rocky beach at low water, hidden in crevices and under stones. A stick, with a hook at the end of it, is inserted in their retreat, and the crab, instantly grasping it, is drawn out. But only a small number, and those not of the finest sort, are taken in this manner, as the largest and strongest crabs betake themselves to the sea on the ebbing of the tide. On a shore which is rugged, and abounding in cavities which afford it a hiding place, the crab is also taken on a small scale by another method. At the spot where they are most numerous, the fisherman places a bait at the end of a small cord, at the other end of which a stone is tied. When the tide flows the crab seizes the bait, which it drags to some hole, and the stone, which it draws after it, closes the entrance. As a stone may be dragged in the water, which cannot be moved by the same power exerted in a less advantageous manner, the animal finds itself a prisoner. The stone must be large enough to close the entrance of the cavity in which the crab conceals itself, and not too heavy to obstruct its movements. But none of these methods are sufficient to provide for an extensive demand.

Crab-fishing, as generally pursued along the British coasts, is conducted by two men who go out in one boat. In addition to their boat they require creels, cruives, or crab-pots, and lines. These creels (in the south of England generally termed crab-pots) are made of dry osier, and resemble basket-work. They are constructed on the same principle as a wire mouse-trap, but the aperture instead of being on the side is at the top. Within the creel the bait, consisting of pieces of thorn-back or skate, is fastened at the bottom, and the creel is then dropped in some favourable situation, three stones of sufficient weight being fastened in the inside to sink it. The creels are sometimes sunk to the depth of twenty fathoms, the fishermen being guided in this respect by the state of the weather or the nature of the ground. In fine weather they are dropped in from three to five fathoms deep; but the crabs are chiefly to be found where the bottom is rocky. A line is fastened to the creel, and at the upper end of the line a cork is attached which floats on the surface. By this means the place where the creel is sunk is known to the fishermen, who usually set from forty to fifty creels at one time. The bait is suspended about the middle of the creel, and can easily be seen by the crabs, which, entering at the aperture, find, like a mouse in a wire-trap, that escape is impossible. The difficulty of egress is increased by the entrance being overhead. Lobsters, prawns, and shrimps are frequently found captured in the same creel with crabs. When the fishermen have sunk the whole of their creels, they have still some time left to proceed farther out to sea for other fish before it is necessary to visit them. Crab-fishing is therefore a valuable addition to their means of livelihood, for it does not preclude the pursuit of other fish at the same season. The demand for this species of shell-fish is usually good, and in the nearest large town on many parts of the coast it is often fully equal to the supply. Thither the fisherman's wife or some of his family may convey the quantity taken; and, if the market be already abundantly provided, they can by means of the well-boxes, although already caught, be kept back for a time until prices rise again. These are all advantages peculiar to this fishery. When a few hours have elapsed, the fishermen visit their creels, one of them rowing and the other keeping a look-out for the floats, and taking out of the creels whatever has been captured. There may perhaps be a dozen different owners of boats thus engaged, and it is therefore necessary to have recourse to some means by which they may each secure the fruits of their individual industry without the risk of dispute. This is accomplished by distinguishing their respective floats by some peculiar mark—by a notch in the side—a mark in the shape of a diamond cut on the top—an angle cut off, &c. &c. The necessity of mutual protection points out to them the value of combination and union, and the marks adopted by the fishermen to distinguish their floats are consequently the result of some common understanding amongst them; or otherwise, of an instinctive regard to the means by which not only one but all are enabled to pursue their calling in confidence and security.

Crabs are brought to market both in a boiled and in a raw state. If the market be distant they are placed in a well-box, which is attached to the outside of the fishing-vessel, and in this manner they are brought to Billingsgate from parts so distant as Norway. The crab is so tenacious of life that it does not lose its vital powers until two or three days after leaving its native element. May, June, and July are the months in which it is generally out of season: but even in these months many may be obtained which are in a perfectly good state for the table. The male is of greater value than the female, and has larger claws. The sexes are distinguished as the cock and the hen. Before boiling, a good crab is known by the roughness of its shell, particularly on the claws. When boiled, the mode of ascertaining its goodness is by holding the claws tight, and shaking the body, which will rattle, or seem as if water were in the inside, if it be not in perfection. The time they are usually boiled is from a quarter of an hour to a couple of hours in sea-water, or in water in which salt has been infused. Sometimes they are put into cold water, which is afterwards heated to the boiling point.

an offspring, but to provide itself a covering; not only to secure a family, but to furnish a house. The animal I mean is the Soldier Crab, which has some similitude to the lobster, if divested of its shell. It is usually about four inches long, has no shell behind, but is covered down to the tail with a rough skin, terminating in a point. It is, however, armed with strong hard nippers before, like the lobster; and one of them is as thick as a man's thumb, and pinches most powerfully. It is, as I said, without a shell to any part except its nippers; but what nature has denied this animal, it takes care to supply by art; and taking possession of the deserted shell of some other animal, it resides in it, till, by growing too large for its habitation, it is under a necessity of change. It is a native of the West India islands; and, like the former, it is seen every year descending from the mountains to the sea-shore, to deposit its spawn, and to provide itself with a new shell. This is a most bustling time with it, having so many things to do; and in fact, very busy it appears. It is very probable that its first care is to provide for its offspring, before it attends to its own wants; and it is thought, from the number of little shells which it is seen examining, that it deposits its spawn in them, which thus is placed in perfect security till the time of exclusion.

However this be, the soldier is in the end by no means unmindful of itself. It is still seen in its old shell, which it appears to have considerably outgrown; for a part of the naked body is seen at the mouth of it, which the habitation is too small to hide. A shell, therefore, is to be found large enough to cover the whole body; and yet not so large as to be unmanageable and unwieldy. To answer both these ends it is no easy matter, nor the attainment of a slight inquiry. The little soldier is seen busily parading the shore along that line of pebbles and shells that is formed by the extremest wave; still, however, dragging its old incommodious habitation at its tail, unwilling to part with one shell, even though a troublesome appendage, till it can find another more convenient. It is seen stopping at one shell, turning it, and passing it by, going on to another, contemplating that for a while, and then slipping its tail from its old habitation, to try on the new. This also is found to be inconvenient; and it quickly returns to its old shell again. In this manner it frequently changes, till at last it finds one light, roomy, and commodious; to this it adheres, though the shell be sometimes so large as to hide the body of the animal, claws and all.[1] Yet it is not only till after many trials, but many combats also, that the soldier is thus completely equipped; for there is often a contest between two of them for some well-looking favourite shell for which they are rivals. They both endeavour to take possession; they strike with their claws, they bite each other, till the weakest is obliged to yield, by giving up the object of dispute. It is then that the victor immediately takes possession, and parades it in his new conquest three or four times backwards and forwards upon the strand before his envious antagonist.

When this animal is taken, it sends forth a feeble cry endeavouring to seize the enemy with its nippers; which if it fastens upon, it will sooner die than quit the grasp. The wound is very painful, and not easily cured. For this reason, and as it is not much esteemed for its flesh, it is generally permitted to return to its old retreat to the mountains in safety. There it continues till the necessity of changing once more, and the desire of producing an offspring expose it to fresh dangers the year ensuing.

[1] Pere du Festre.

CHAP. III.

OF THE TORTOISE AND ITS KINDS.

Having described the lobster and the crab as animals in some measure approaching to the insect tribes, it will appear like injustice to place the Tortoise among the number, that from its strength, its docility, and the warm red blood that is circulating in its veins, deserves to be ranked even above the fishes. But as this animal is covered, like the lobster, with a shell; as it is of an amphibious nature, and brings forth its young from the egg without hatching; we must be content to degrade it among animals that in every respect it infinitely surpasses.

Tortoises are usually divided into those that live upon land, and those that subsist in the water; and use has made a distinction even in the name; the one being called Tortoises, the other Turtles. However, Seba has proved that all tortoises are amphibious; that the land tortoise will live in the water, and that the sea turtle can be fed upon land. A land tortoise was brought to him that was caught in one of the canals of Amsterdam, which he kept for half a year in his house, where it lived very well contented in both elements. When in the water, it remained with its head above the surface; when placed in the sun, it seemed delighted with its beams, and continued immovable while it felt their warmth. The difference, therefore, in these animals, arises

rather from their habits than their conformation; and, upon examination, there will be less variety found between them than between birds that live upon land, and those that swim upon the water.

Yet, though nature seems to have made but few distinctions among these animals, as to their conformation, yet, in their habits, they are very dissimilar; as these result from different qualities of their food, and the different sorts of enemies they have to avoid or encounter. I will therefore exhibit their figure and conformation under one common description, by which their slight differences will be more obvious; and then I will give a separate history of the manners of each, as naturalists and travellers have taught us.

All tortoises, in their external form, pretty much resemble each other; their outward covering being composed of two great shells, the one laid upon the other, and only touching at the edges: however, when we come to look closer we shall find that the upper shell is composed of no less than thirteen pieces, which are laid flat upon the ribs, like the tiles of a house, by which the shell is kept arched and supported. The shells both above and below that, which seem, to an inattentive observer, to make each but one piece, are bound together at the edges by very strong and hard ligaments, yet with some small share of motion. There are two holes at either edge of this vaulted body; one for a very small head, shoulders, and arms, to peep through; the other at the opposite edge, for the feet and the tail. These shells the animal is never disengaged from; and they serve for its defence against every creature but man.[1]

The *tortoise* has but a small head, with no teeth; having only two bony ridges in the place, serrated and hard. These serve to



gather and grind its food; and such is the amazing strength of the jaws, that it is impossible to open them where they once have fastened. Even when the head is cut off, the jaws still keep their hold; and the muscles in death, preserve a tenacious rigidity. Indeed, the animal is possessed of equal strength in all other parts of its body: the legs, though short, are inconceivably strong; and torpid as the tortoise may appear, it has been known to carry five men standing upon its back, with apparent ease and unconcern. Its manner of going forward is by moving its legs one after the other; and the claws with which the toes are furnished, sink into the ground like the nails of an iron-shod wheel, and thus assist its progression.

With respect to its internal parts, not to enter into minute anatomical disquisitions, it may not be improper to observe, that the blood circulates in this animal as in some cartilaginous fishes, and something in the manner of a child in the womb. The greatest quantity of the blood passes directly from the vena cava into the left ventricle of the heart, which communicates with the right ventricle by an opening; while the auricles only receive what the ventricles seem incapable of admitting. Thus the blood is driven by a very short passage through the circulation; and the lungs seem to lend only occasional assistance. From this conformation, the animal can subsist for some time, without using the lungs, or breathing; at least the lungs are not so necessary an instrument for driving on the circulation as with us.

Such is the general structure of this animal, whether found to live by land or water. With regard to the differences of these animals, the land-tortoise, from its habits of making use of its feet in walking, is much more nimble upon land than the sea-turtle: the land-tortoise, if thrown upon its back, by rocking and balancing its body, like a child rocking in a cradle, at last turns itself upon its face again; but the turtle, when once turned, continues without being able to move from the spot. In comparing the feet also of these animals, the nails upon the toes of one that has long been used to scratch for subsistence upon land, are blunt and worn; while those that have only been employed in swimming, are sharp and long, and have more the similitude of fins. The brain of the land-tortoise is but small; and yet it is three times as large as that of the turtle.—There is a difference also in the shape of their eggs, and in the passage by which they are excluded; for, in the land-tortoise, the passage is so narrow, that the egg conforms to the shape of the aperture, and though round when in the body, yet becomes much more oblong than those of fowls upon being excluded; otherwise they would never be able to pass through the bony canal by which they are protruded; on the contrary, the passage is wider in the turtle, and therefore its eggs are round. These are the most striking distinctions; but that which is most known is their size; the land-tortoise

[1] There are various species of land tortoise, such as the Indian tortoise—the Radiated tortoise—the Tabular tortoise—the Geometrical tortoise—the Starred tortoise—the Leopard tortoise—the Kinyxis tortoise, &c.—and the Emys tortoise, which latter term is employed to designate the species that live habitually in fresh water.

often not exceeding three feet long, by two feet broad; the sea-turtle being sometimes from five to seven feet long. The size, however, is but a fallacious distinction: since land-tortoises, in some parts of India, grow to a very great magnitude; though probably not, as the ancients affirm, big enough for a single shell to serve for the covering of a house.

But if the different kinds of tortoises are not sufficiently distinguished by their figure, they are very obviously distinguishable by their methods of living. The land-tortoise lives in holes dug in the mountains, or near marshy lakes; the sea-turtle in cavities of rocks, and extensive pastures at the bottom of the sea. The tortoise makes use of its feet to walk with, and burrow in the ground; the turtle chiefly uses its feet in swimming or creeping at the bottom.

The land-tortoise is generally found, as was observed above, from one foot to five feet long, from the end of the snout to the end of the tail; and from five inches to a foot and a half across the back. It has a small head, somewhat resembling that of a serpent; an eye without the upper lid; the under eye-lid serving to cover and keep that organ in safety. It has a strong scaly tail, like the lizard. Its head the animal can put out and hide at pleasure, under the great penthouse of its shell; there it can remain secure from all attacks; there, defended on every side, it can fatigue the patience of the most formidable animal of the forest, that makes use only of natural strength to destroy it. As the tortoise lives wholly upon vegetable food, it never seeks the encounter; yet, if any of the smaller animals attempt to invade its repose, they are sure to suffer. The tortoise, impregnably defended, is furnished with such a strength of jaw, that, though armed only with bony plates instead of teeth, wherever it fastens it infallibly keeps its hold, until it has taken out the piece.

Though peaceable in itself, it is formed for war in another respect, for it seems almost endued with immortality. Nothing can kill it; the depriving it of one of its members, is but a slight injury: it will live, though deprived of the brain; it will live, though of its head. Redi informs us, that in making some experiments upon vital motion, he, in the beginning of the month of November, took a land-tortoise, made a large opening in its skull, and drew out all the brain, washed the cavity, so as not to leave the smallest part remaining, and then leaving the hole open, set the animal at liberty. Notwithstanding this, the tortoise marched away without seeming to have received the smallest injury; only it shut the eves. and never opened them afterwards. Soon after the hole in the skull was seen to close; and in three days, there was a complete skin covering the wound. In this manner the animal lived without a brain, for six months; walking about unconcernedly, and moving its limbs as before. But the Italian philosopher, not satisfied with this experiment, carried it still farther; for he cut off the head, and the animal lived twenty-three days after its separation from the body. The head also continued to rattle the jaws, like a pair of castanets, for above a quarter of an hour.

Nor are these animals less long-lived than difficult in destroying. Tortoises are commonly known to exceed eighty years old; and there was one kept in the Archbishop of Canterbury's garden, at Lambeth, that was remembered above a hundred and twenty. It was at last killed by the severity of a frost, from which it had not sufficiently defended itself in its winter retreat, which was a heap of sand, at the bottom of the garden.[1]

[1] "From a document belonging to the archives of the cathedral, called the Bishop's Barn, it is well ascertained that the tortoise at Peterborough must have been about 220 years old. Bishop Marsh's predecessor in the see of Peterborough had remembered it above sixty years, and could recognize no visible change. He was the seventh bishop who had worn the mitre during its sojourn there. If I mistake not, its sustenance and abode were provided for in this document. Its shell was perforated, in order to attach it to a tree, &c., to limit its ravages among the strawberry borders. The animal had its antipathies and predilections. It would eat endive, green peas, and even the leek; while it positively rejected asparagus, parsely, and spinage. In the early part of the season, its favourite pabulum were the flowers of the dandelion, of which it would devour *twenty* at a meal; and lettuce, of the latter a good sized one at a time; but if placed between lettuce and the flowers of the dandelion, it would forsake the former for the latter. It was also partial to the pulp of an orange, which it sucked greedily. About the latter end of June, (discerning the times and the seasons,) it looked out for fruit, when its former choice was forsaken. It ate currants, raspberries, pears, apples, peaches, nectarines, &c., the riper, the better, but would not taste cherries. Of fruits, however, the strawberry and gooseberry were the most esteemed: it made great havoc among the strawberry borders, and would take a pint of gooseberries at intervals. The gardener told me it knew him well, the hand that generally fed it, and would watch him attentively at the gooseberry bush, where it was sure to take its station while he plucked the fruit. I could not get it to take the root of the dandelion, nor indeed any root I offered it, as that of the carrot, turnip, &c. All animal food was discarded, nor would it take any liquid; at least neither milk nor water; and when a leaf was moist, it would shake it to expel the adhering wet. This animal moved with apparent ease, though pressed by a weight of eighteen stones; itself weighed 13½ lbs. In cloudy weather it would scoop out a cavity, generally in a southern exposure, where it reposed, torpid and inactive, until the genial influence of the sun roused it from its slumber. When in this state the eyes were closed, and the head and neck a little contracted, though not drawn within the shell. Its sense of smelling was so acute, that it was roused from its lethargy if any person approached,

The usual food of the land tortoise seems not so nourishing as to supply this extraordinary principle of vitality. It lives upon vegetables in its retreats in the mountains or the plain; and seldom makes its prey of snails or worms, but when other food is not found in grateful plenty. It is fond also of fruits; and when the forest affords them, is generally found not far from where they grow. As it can move but slowly, it is not very delicate in the choice of its food; so that it usually fills itself with whatever offers. Those that are kept in a domestic state will eat any thing; leaves, fruits, corn, bran, or grass.

From the smallness of its brain, and the slowness of its motion, it obviously appears to be a torpid heavy animal, requiring rest and sleep; and, in fact, it retires to some cavern to sleep for the winter. I already observed that its blood circulated through the heart by a short passage; and that it did not, as anatomists express it, go through the great circulation. With us, and quadrupeds, the blood goes from the veins to the heart; and from the heart it is sent to be spread over the lungs; from the lungs it returns to the heart again; and from thence it goes to the arteries to be distributed through the whole body. But its passage in the tortoise is much shorter; for, from the veins it goes to the heart; then leaving the lungs entirely out of its course, it takes a short cut, if I may so say, into the beginning of the arteries, which send it round the animal frame. From hence we see the lungs are left out of the circulation; and, consequently, the animal is capable of continuing to live without continuing to breathe. In this it resembles the bat, the serpent, the mole, and the lizard; like them it takes up its dark residence for the winter; and, at that time, when its food is no longer in plenty, it happily becomes insensible to the want. Nor is it unmindful to prepare its retreat, and make it as convenient as possible; it is sometimes buried two or three feet in the ground, with its hole furnished with moss, grass, and other substances, as well to keep the retreat warm, as to serve for food, in case it should prematurely awake from its state of stupefaction. But it must not be supposed, that, while it is thus at rest, it totally discontinues to breathe; on the contrary, an animal of this kind, if put into a close vessel, without air, will soon be stifled; though not so readily as in a state of vigour and activity.

From this dormant state the tortoise is awakened by the genial return of spring; and is thought not to be much wasted by its long confinement. To animals that live a hundred and fifty years, a sleep of six months is but as the nap of a night. All the actions of these long-lived creatures seem formed upon a scale answering the length of their existence; their slumbers are for a season; their motions are slow, and require time in every action; even the act of procreation, which among other animals is performed in a very few minutes, is with them the business of days. About a month after their enlargement from a torpid state, they prepare to transmit their posterity; and both continue joined for near a month together. The eggs of the female are contained in the ovary, above the bladder, which is extremely large; and these are, before their exclusion, round and naked, with some spots of red; after they are laid, however, they assume another form, being smaller and longer than those of a hen. This alteration in the figure of the eggs most probably proceeds from the narrowness of the bony passage through which they are excluded. Swammerdam, who compared the size of the eggs taken out of this animal's body with the diameter of the passage through which they were excluded, was of opinion that the bones themselves separated from each other, and closed again; but, in my opinion, it is more probable to suppose, that the eggs, and not the bones, alter their form. Certain it is, that they are round in the body, and that they are oval upon being protruded.

The eggs of all the tortoise kind, like those of birds, are furnished with a yolk and a white; but the shell is different, being somewhat like those soft eggs that hens exclude before their time; however, this shell is much thicker and stronger, and is a longer time in coming to maturity in the womb. The land-tortoise lays but a few in number, if compared to the sea-turtle, who deposits from a hundred and fifty to two hundred in a season.

The amount of the land-tortoise's eggs I have not been able to learn;[1] but, from the scarceness of the animal, I am apt to think they cannot be numerous. When it prepares

even at a distance of twelve feet. About the beginning of October, or latter end of September, it began to immure itself, and had for that purpose for many years selected a particular angle of the garden; it entered in an inclined plane, excavating the earth in the manner of the mole; the depth to which it penetrated varied with the character of the approaching season, being from one to two feet, according as the winter was mild or severe. It may be added, that for nearly a month prior to this entry into its dormitory, it refused all sustenance whatever. The animal emerged about the end of April, and remained for at least a fortnight before it ventured on taking any species of food. Its skin was not perceptibly cold: its respiration, entirely effected through the nostrils, was languid. I visited the animal, for the last time, on the 9th June, 1813, during a thunder storm: it then lay under the shelter of a cauliflower, and apparently torpid."—*Murray's Experimental Researches.*

[1] Land tortoises are supposed to lay five or six eggs, but on this point we have no very positive information.

to lay, the female scratches a slight depression in the earth, generally in a warm situation, where the beams of the sun have their full effect: there depositing her eggs, and covering them with grass and leaves, she forsakes them, to be hatched by the heat of the season. The young tortoises are generally excluded in about twenty-six days; but, as the heat of the weather assists, or its coldness retards incubation, sometimes it happens that there is a difference of two or three days. The little animals no sooner leave the egg than they seek for their provision, entirely self-taught; and their shell, with which they are covered from the beginning, expands and grows larger with age. As it is composed of a variety of pieces, they are all capable of extension at their sutures, and the shell admits of increase in every direction. It is otherwise with those animals, like the lobster, whose shell is composed all of one piece, that admits of no increase; which, when the tenant is too big for the habitation, must burst the shell, and get another. But the covering of the tortoise grows larger in proportion as the internal parts expand; in some measure resembling the growth of the human skull, which is composed of a number of bones, increasing in size in proportion to the quantity of the brain. All tortoises, therefore, as they never change their shell, must have it formed in pieces; and though in some that have been described by painters or historians, these marks have not been attended to, yet we can have no doubt that they are general to the whole tribe.

It is common enough to take these animals into gardens, as they are thought to destroy insects and snails in great abundance. We are even told that in hot countries, they are admitted into a domestic state, as they are great destroyers of bugs. How so large and heavy an animal is capable of being expert at such petty prey is not easy to conceive; but I have seen several of them about gentlemen's houses, that, in general, appear torpid, harmless, and even fond of employment. Children have sometimes got upon the back of a tortoise; and such was the creature's strength, that it never seemed overloaded, but moved off with its burden to where it expected to be fed, but would carry them no further. In winter they regularly find out a place to sleep in; but in those warm countries in which the tortoise is found larger, and in greater plenty than in Europe, they live, without retiring, the whole year round.

The Sea Tortoise, or Turtle, as it is now called, is generally found larger than the former. This element is possessed with the property of increasing the magnitude of those animals, which are common to the land and the ocean. The sea pike is larger than that of fresh water; the sea bear is larger than that of the mountains; and the sea turtle exceeds the land tortoise in the same proportion. It is of different magnitudes, according to its different kinds; some turtles being not above fifty pounds weight, and some above eight hundred.

The *Great Mediterranean Turtle* (or Coriaceous Turtle)[1] is the largest of the turtle kind with which we are acquainted. It is found from



five to eight feet long, and from six to nine hundred pounds weight. But, unluckily, its utility bears no proportion to its size; as it is unfit for food, and sometimes poisons those who eat it. The shell also, which is a tough strong integument, resembling a hide, is unfit for all serviceable purposes. One of these animals was taken in the year 1729, at the mouth of the Loire, in nets that were not designed for so large a capture. This turtle, which was of enormous strength, by its own struggles involved itself in the nets in such a manner as to be incapable of doing mischief: yet, even thus shackled, it appeared terrible to the fishermen, who were at first for flying; but finding it impotent, they gathered courage to drag it on shore, where it made a most horrible bellowing; and when they began to knock it on the head with their gaffs, it was to be heard at half a mile's distance. They were still farther intimidated by its nauseous and pestilential breath, which so powerfully affected them, that they were near fainting. This animal wanted but four inches of being eight feet long, and was above two feet over: its shell more resembled leather than the shell of a tortoise; and, unlike all other animals of this kind, it was furnished with teeth in each jaw, one rank behind another, like those of a shark: its feet also, different from the rest of this kind, wanted claws; and the tail was quite disengaged from the shell, and fifteen inches long, more resembling that of a quadruped than a tortoise. This animal was then unknown upon the coasts of France, and was supposed to have been brought into the European seas, in some India ship that might be wrecked upon her return. Since that, however, two or three of these animals have been

[1] Also called the *Leathery Turtle*, from its tough leathery covering.

taken upon the coasts; two in particular upon those of Cornwall, in the year 1756, the largest of which weighed eight hundred pounds; and one upon the isle of Rhe, but two years before, that weighed between seven and eight hundred. One, most probably of this kind also, was caught about thirty years ago near Scarborough, and a good deal of company was invited to feast upon it: a gentleman, who was one of the guests, told the company that it was a Mediterranean turtle, and not wholesome; but a person, who was willing to satisfy his appetite at the risk of his life, ate of it: he was seized with a violent vomiting and purging; but his constitution overpowered the malignity of the poison.

These are a formidable and useless kind, if compared to the turtle caught in the South seas and the Indian ocean. These are of different kinds; not only unlike each other in form, but furnishing man with very different advantages. They are usually distinguished by sailors into four kinds; the Trunk Turtle, the Loggerhead, the Hawksbill, and the Green Turtle.

The Trunk Turtle is commonly larger than the rest, and its back higher and rounder. The flesh of this is rank, and not very wholesome.

The Loggerhead is so called from the largeness of its head, which is much bigger in proportion than that of the other kinds.[1] The flesh of this also is very rank, and not eaten but in case of necessity.

The Hawksbill Turtle (or Imbricated Turtle) is the least of the four, and has a long and small mouth, somewhat resembling the bill of a hawk.[2] The flesh of this also is very indif-

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[1] *The Loggerhead Turtle.*—The Loggerhead turtle (*testudo caretta*) has some resemblance to the green turtle; but the head is larger, the shell broader, and the colours more intense. There are also two more pieces in the



back plate, and the fore legs are longer and the hind legs shorter in proportion. It is much more active than the green turtle, and ranges over a much greater extent in latitude. It is by no means uncommon in the Mediterranean, not merely on the coasts of Africa, but on those of Italy and Sicily. The flesh is tough and harsh, though eaten by the poor. The shell too, is thin, dull, and of little value, though the Italian workmen sometimes use it in veneering. The principal value of the animal is for its oil, which is abundant, considerably superior to whale-oil, and some suppose it would answer well for the dressing of leather, for which cod-oil, made from the liver, is chiefly used in this country. The eggs of the loggerhead are more palatable than the flesh.

The loggerhead is as formidable and fierce as the green turtle is gentle and inoffensive. Its jaws are very hard and strong, and they come together with much force. They are, however, well adapted to its food, the principal part of which is shelled animals, and it can easily break the hardest shell. It can also strike and scratch with its long fore legs, which have strong claws projecting beyond the webs of the toes. It will snap at a stick or any other object with which it is threatened; and its hold is so firm that it will break a thick stick, or bend a rod of iron. It is exceedingly difficult to get it to quit its hold after once it has been taken; and it is commonly said that the "loggerhead" continues to bite after it has been separated from the body. The hold which, in that case it retains, is not the stiffness of death, for the head of any tortoise lives for some time after it has been cut off.

These animals are formidable in size, too; for it has been said that some weighing 1500 or 1600 pounds have been met with. They also swim with more rapidity than the green turtle, being much more frequently met with "on the high seas." When young, they have so great a resemblance to the green turtle as to lead to a suspicion that the specimens met with on the western coast of France, and described as green turtle, were in fact loggerheads; because green turtle have not been found in the Mediterranean, the shores of which have a much more tropical character than the coast of France. It is probable that all the green turtle described as being found far out at sea, were in truth the species now under consideration. As a grazing animal, the green turtle is not likely to go often or far to places where it can find no bottom, while the loggerhead, a devourer of flesh, can range the ocean at its pleasure. In Europe this turtle is not often found to the north of the Mediterranean; and in America it is seldom found to the north of Florida. As it has not the same charms for the palate of the epicure, its habits, though it has been much longer known, have not been so much studied as those of the other.

[2] *The Hawksbill Turtle.* — The Hawksbill turtle (*Testudo imbricata*) gets its scientific name from the arrangement of the plates, which overlap each other like the tiles on a roof; and it gets its common English name from the partial resemblance of its mouth, seen in profile, to the bill of a hawk. Its head, neck, and legs are longer in proportion to their thickness than those of the other turtles; it is more active, swimming with greater velocity, and righting itself when turned. Its eggs are eatable, but its flesh is not good, and the chief value of it to man are the plates on its back, which are the true tortoise-shell of commerce, and have been highly esteemed from the earliest ages. There are thirteen plates in the central part, surrounded by twenty-five smaller ones. The large central plates are the finest shell; and they are often of considerable thickness. The plates of shell do not form the entire case of the animal. The inner or supporting part is bony, and may be considered as part of the skeleton. The true skin is between the bony substance and the plates of shell. The plates are a production of that skin, and in the living state they are covered by an epidermis, or scarfskin. The common way of obtaining the plates is to heat the entire backpiece of the animal, by fire applied under the hollow on the inside. By that means the gelatine of the skin is dissolved, the skin itself swells, and the plates are easily detached entire. A turtle of about 300 pounds weight will produce about ten or twelve pounds of shell; but in the common way of obtaining the shell, the animal, which is otherwise useless in the arts, is sacrificed. In the eastern isles, where the hawksbill turtle is very abundant, the Malays, who procure large quantities of shell for the Chinese, pursue a different method. They catch the turtle alive, and retain it while they detach the central plates, so dexterously as not to lacerate the

ferent eating; but the shell serves for the most valuable purposes. This is the animal that supplies the tortoise-shell, of which such a variety of beautiful trinkets are made. The substance of which the shells of other turtle are composed is thin and porous; but that of the hawksbill is firm, and when polished, is beautifully marbled. They generally carry about three pounds; but the largest of all, six pounds. The shell consists, as in all the kind, of thirteen leaves or plates, of which eight are flat, and five hollow. They are raised and taken off by means of fire, which is made under the shell after the flesh is taken out. As soon as the heat affects the leaves, they start from the ribs, and are easily raised with the point of a knife. By being scraped and polished on both sides, they become beautifully transparent, or are easily cast into what form the workman thinks proper, by making them soft and pliant in warm water, and then screwing them in a mould, like a medal: however, the shell is most beautiful before it undergoes this last operation.

But of all animals of the tortoise kind, the Green Turtle[1] is the most noted and the most valuable. The delicacy of its flesh, and its nutritive qualities, together with the property of being easily digested, were, for above a century, known only to our seamen, and the inhabitants of the coasts where they were taken. It was not till by slow degrees the distinction came to be made between such as were malignant and such as were wholesome. The controversies and contradictions of our old travellers were numerous upon this head: some asserting, that the turtle was delicious food; and others, that it was actual poison. Dampier, that rough seaman, who has added more to natural history than half of the philosophers that went before him, appears to be the first who informed us of their distinctions; and that, while the rest might be valuable for other purposes, the green turtle alone was chiefly prized for the delicacy of its flesh. He never imagined, however, that this animal would make its way to the luxurious tables of Europe; for he seems chiefly to recommend it as salted up for ship's provision, in case of necessity.

At present the turtle is very well known among us, and is become the favourite food of those that are desirous of eating a great deal without the danger of surfeiting. This is a

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skin. The animal is said not to show much uneasiness during the operation, and when that is performed it is returned into the sea, where, after a time, the plates are said to be reproduced. That is by no means unlikely, as the reproduction of parts is not uncommon among reptiles, any more than among some of the crustacea, which have at least some analogy with the reptiles.

The hawksbill, or shell turtle, is much more widely diffused than the green turtle. It is found in almost all the tropical seas; being peculiarly abundant in the shallows near Belese, the chief settlement in the mahogany country of Honduras. It is indeed general in the Caribbean sea; and is found browsing on its favourite sea weed, wherever that abounds in latitudes sufficiently warm. It is also plentiful on the shores of tropical Africa, on those of New Holland, and in the Indian ocean. Tortoise-shell is thus so abundant, that though it has been a favourite article of luxury from very early times, the supply is still undiminished.

[1] *The Green Turtle.*—The Green turtle, of which we hear so much as a luxury at the tables of the rich, is a native of the seas in the warm and tropical parts of the world; and instead of being considered as a rarity or a



dainty there, it is so abundant, that the flesh of it is sold cheaper than that of any land animal. The tropical shores of America, both on the Atlantic and the Pacific side, the tropical shores of Africa, and those of New Holland, are the favourite haunts of the turtle. These animals prefer lonely places, and thus they are much more plentiful on desert shores and about little barren islands, than they are on those of fertile countries. The little isles called the Alligator isles, in the West Indian sea; the barren volcanic rocks of the Gallipagos in the Pacific; the island of Ascension, in the Atlantic, and the northern shores of New Holland, which are generally speaking, dreary and barren, abound more with them than any other parts of the world. The green turtle attains an enormous size and weight; some individuals measuring six or seven feet in length from the tip of the nose to the extremity of the tail, by three or four feet broad, and weighing as much as eight hundred pounds. The more common weight, however, is from two to three hundred pounds.

The instinct which leads the female turtle to the shore to lay her eggs, exposes her to the danger of becoming the prey of man. She deposits her eggs on the loose sand, and abandons them at once to the chance, which approaches almost to a certainty in the southern hemisphere, that they will be hatched by the influence of the sun's rays. She digs, by means of her fore-feet, one or more holes about a foot wide and two feet deep, in which she usually deposits more than a hundred eggs. These eggs are round, and are two or three inches in diameter; they are covered with a membrane something like wet parchment. The female generally lays three times in each year, at intervals of about a fortnight or three weeks. They almost always go ashore in the night time. A loose sand being essential to the hatching of the eggs, the turtles frequent only particular shores; but these are often several hundred miles from their feeding places. The eggs are hatched in less than a month after they are laid; and in about eight or ten days the young reptiles crawl to the water. Few however, reach their native element, in proportion to the number produced. They become the prey of seafowl and various quadrupeds of prey. The tiger is an especial enemy to the tortoise; but man is still more actively engaged in their destruction. The collection of tortoise eggs forms one of the most important of the occupations of the Indians of the Orinoco. Humboldt gives an interesting account of this branch of commerce.

property the flesh of the turtle seems peculiarly possessed of; and by the importation of it alive among us, gluttony is freed from one of its greatest restraints. The flesh of the turtle is become a branch of commerce; and therefore ships are provided with conveniences for supplying them with water and provision, to bring them over in health from Jamaica and other West India islands. This, however, is not always effected; for though they are very vivacious, and scarcely require any provision upon the voyage, yet, by the working of the ship, and their beating against the sides of the boat that contains them, they become battered and lean; so that to eat this animal in the highest perfection, instead of bringing the turtle to the epicure he ought to be transported to the turtle.

This animal is called the green turtle, from the colour of its shell, which is rather greener than that of others of this kind. It is generally found about two hundred weight; though some are five hundred, and others not above fifty. Dampier tells us of one that was seen at Port-Royal, in Jamaica, that was six feet broad across the back; he does not tell us its other dimensions; but says that the son of Captain Roach, a boy about ten years old, sailed in the shell, as in a boat, from the shore to his father's ship, which was above a quarter of a mile from land. But this is nothing to the size of some turtles the ancients speak of. Ælian assures us, that the houses in the island of Taprobane are usually covered with a single shell. Diodorus Siculus tells us that a people neighbouring on Ethiopia, called the *Turtle-eaters*, coasted along the shore in boats made of the upper shell of this animal; and that in war, when they had eaten the flesh, the covering served them as a tent. In this account, Pliny, and all the rest of the ancients, agree; and as they had frequent opportunities of knowing the truth, we are not lightly to contradict their testimony.

At present, however, they are not seen of such amazing dimensions. We are told by Laet, that on the isle of Cuba they grow to such a size, as that five men can stand on the back of one of them together; and what is more surprising still, that the animal does not seem overloaded, but will go off with them upon its back, with a slow steady motion, towards the sea.

They are found in the greatest numbers on the island of Ascension; where for several years, they were taken to be salted to feed the slaves, or for a supply of ship's provision. Their value at present seems to be better known.

This animal seldom comes from the sea but to deposit its eggs, and now and then to sport in fresh water. Its chief food is a submarine plant, that covers the bottom of several parts of the sea not far from the shore. There the turtles are seen, when the weather is fair, feeding in great numbers, like flocks of sheep, several fathoms deep, upon the verdant carpet below. At other times they go to the mouths of rivers; and they seem to find gratification in fresh water. After some time thus employed, they seek their former stations: and when done feeding, they generally float with their heads above water, unless they are alarmed by the approach of hunters or birds of prey, in which case they suddenly plunge to the bottom. They often seek their provision among the rocks, feeding upon moss and sea-weed; and it is probable will not disdain to prey upon insects and other small animals, as they are very fond of flesh when taken and fed for the table.

At the time of breeding, they are seen to forsake their former haunts and their food, and to take sometimes a voyage of nine hundred miles to deposit their eggs on some favourite shore. The coasts they always resort to upon these occasions are those that are low, flat, and sandy: for, being heavy animals, they cannot climb a bold shore; nor is any bed so proper as sand to lay their eggs on. They couple in March, and continue united till May; during a great part of which they are seen locked together, and almost incapable of separation. The female seems passive and reluctant; but the male grasps her with his claws in such a manner, that nothing can induce him to quit his hold. It would seem that the grasp, as in frogs, is, in some measure, convulsive, and that the animal is unable to relax its efforts.

When the time for laying approaches, the female is seen towards the setting of the sun drawing near the shore, and looking earnestly about her, as if afraid of being discovered. When she perceives any person on shore, she seeks for another place; but if otherwise, she lands when it is dark, and goes to take a survey of the sand where she designs to lay. Having marked the spot, she goes back without laying, for that night, to the ocean again; but the next night returns to deposit a part of her burden. She begins by working and digging in the sand with her fore-feet till she has made a round hole, a foot broad, and a foot and a half deep, just at the place a little above where the water reaches highest. This done, she lays eighty or ninety eggs at a time, each as big as a hen's egg, and as round as a ball. She continues laying about the space of an hour; during which time, if a cart were driven over her, she would not be induced to stir. The eggs are covered with a tough white skin, like wetted parchment. When she has done laying, she covers the hole so dexterously, that it is no easy matter to find

the place; and those must be accustomed to the search to make the discovery. When the turtle has done laying, she returns to the sea, and leaves her eggs to be hatched by the heat of the sun. At the end of fifteen days she lays about the same number of eggs again; and at the end of another fifteen days she repeats the same; three times in all, using the same precautions every time for safety.

In about twenty-four or twenty-five days after laying, the eggs are hatched by the heat of the sun; and the young turtles being about as big as quails, are seen bursting from the sand, as if earth-born, and running directly to the sea, with instinct only for their guide: but, to their great misfortune, it often happens that, their strength being small, the surges of the sea, for some few days, beat them back upon the shore. Thus exposed, they remain a prey to thousands of birds that then haunt the coast; and these stooping down upon them carry off the greatest part, and sometimes the whole brood, before they have strength sufficient to withstand the waves, or dive to the bottom. Helbigius informs us, that they have still another enemy to fear, which is no other than the parent that produces them, that waits for their arrival at the edge of the deep, and devours as many as she can.[1] This circumstance, however, demands further confirmation; though nothing is more certain than that the crocodile acts in the same unnatural manner.

When the turtles have done laying, they then return to their accustomed places of feeding. Upon their outset to the shore where they breed, they are always fat and healthy; but upon their return, they are weak, lean, and unfit to be eaten. They are seldom, therefore, molested upon their retreat; but the great art is to seize them when arrived, or to intercept their arrival. In these uninhabited islands, to which the green turtle chiefly resorts, the men that go to take them land about night-fall, and without making any noise (for these animals, though without any external opening of the ear, hear very distinctly, there being an auditory conduit that opens into the mouth,) lie close while they see the female turtle coming on shore. They let her proceed to her greatest distance from the sea; and then, when she is most busily employed in scratching a hole in the sand, they sally out and surprise her. Their manner is to turn her upon her back, which utterly incapacitates her from moving; and yet as the creature is very strong, and struggles very hard, two men find it no easy matter to lay her over. When thus secured they go to the next; and in this manner, in less than three hours, they have been known to turn forty or fifty turtles, each of which weighs from a hundred and fifty to two hundred pounds. Labat assures us, that when the animal is in this helpless situation, it is heard to sigh very heavily, and even to shed tears.

At present, from the great appetite that man has discovered for this animal, they are not only thinned in their numbers, but are also grown much more shy. There are several other ways, therefore, contrived for taking them.[2] One is, to seize them when coupled

[1] This account of the turtle's preying upon its young is incorrect.

[2] Audubon, in his *Ornithological Biography*, has a chapter, headed *The Turtlers*, in which he gives an interesting account of the habits of turtles, and the methods of taking them. "The Tortugas," he says, "are a group of islands lying about eighty miles from Key West, and the last of those that seem to defend the peninsula of the Floridas. They consist of five or six extremely low uninhabitable banks formed of shelly sand, and are resorted to principally by that class of men called Wreckers and Turtlers. Between these islands are deep channels, which, although extremely intricate, are well known to those adventurers, as well as to the commanders of the revenue cutters, whose duties call them to that dangerous coast. The great coral reef or wall lies about eight miles from these inhospitable isles, in the direction of the Gulf, and on it many an ignorant or careless navigator has suffered shipwreck. The whole ground around them is densely covered with corals, sea-fans, and other productions of the deep, amid which crawl innumerable testaceous animals, while shoals of curious and beautiful fishes fill the limpid waters above them. Turtles of different species resort to these banks, to deposit their eggs in the burning sand, and clouds of sea-fowl arrive every spring for the same purpose. These are followed by persons called 'Eggers,' who, when their cargoes are completed, sail to distant markets, to exchange their ill-gotten ware for a portion of that gold, on the acquisition of which all men seem bent. . . . . .

"But the Tortugas are not the only breeding places of the turtles; these animals, on the contrary, frequent many other keys, as well as various parts of the coast of the mainland. There are four different species, which are known by the names of the *green* turtle, the *hawksbill* turtle, the *loggerhead* turtle, and the *trunk* turtle. The first is considered the best as an article of food, in which capacity it is well known to most epicures. It approaches the shores, and enters the bays, inlets, and rivers, early in the month of April, after having spent the winter in the deep waters. It deposits its eggs in convenient places, at two different times in May, and once again in June. The first deposit is the largest, and the last the least, the total quantity being at an average about two hundred and forty. The hawksbill turtle, whose shell is so valuable as an article of commerce, being used for various purposes in the arts, is the next with respect to the quality of its flesh. It resorts to the outer keys only, where it deposits its eggs in two sets, first in July, and again in August, although it 'crawls' the beaches of these keys much earlier in the season, as if to look for a safe place. The average number of its eggs is about three hundred. The loggerhead visits the Tortugas in April, and lays from that period until late in June three sets of eggs, each set averaging a hundred and seventy. The trunk turtle, which is sometimes of an enormous size, and which has a pouch like a pelican, reaches the shores latest. The shell and flesh are so soft that one may push his finger into them, almost as

together, at the breeding season, when they are very easily approached, and as easily seen; for these animals, though capable of living for some time under water, yet rise every eight or ten minutes to breathe. As soon as they are thus perceived, two or three people draw near them in a canoe, and slip a noose either round their necks or one of their feet. If they have no line, they lay hold of them by the neck, where they have no shell,

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into a lump of butter. This species is therefore considered as the least valuable, and indeed is seldom eaten, unless by the Indians, who, ever alert when the turtle season commences, first carry off the eggs, and afterwards catch the turtles themselves. The average number of eggs which it lays in the season, in two sets, may be three hundred and fifty.

"The loggerhead and the trunk turtles are the least cautious in choosing the places in which to deposit their eggs, whereas the two other species select the wildest and most secluded spots. The green turtle resorts either to the shores of the main, between Cape Sable and Cape Florida, or enters Indian, Halifax, and other large rivers or inlets, from which it makes its retreat as speedily as possible, and betakes itself to the open sea. Great numbers, however, are killed by the turtlers and Indians, as well as by various species of carnivorous animals, as cougars, lynxes, bears, and wolves. The hawksbill, which is still more wary, and is always the most difficult to surprise, keeps to the sea islands. All the species employ nearly the same method in depositing their eggs in the sand, and as I have several times observed them in the act, I am enabled to present you with a circumstantial account of it.

"On first nearing the shores, and mostly on fine calm moonlight nights, the turtle raises her head above the water, being still distant thirty or forty yards from the beach, looks around her, and attentively examines the objects on the shore. Should she observe nothing likely to disturb her intended operations, she emits a loud hissing sound, by which such of her many enemies as are unaccustomed to it are startled, and so are apt to remove to another place, although unseen by her. Should she hear any noise, or perceive indications of danger, she instantly sinks and goes off to a considerable distance; but should every thing be quiet, she advances slowly towards the beach, crawls over it, her head raised to the full stretch of her neck; and when she has reached a place fitted for her purpose, she gazes all round in silence. Finding 'all well,' she proceeds to form a hole in the sand, which she effects by removing it from *under* her body with her *hind* flappers, scooping it out with so much dexterity that the sides seldom if ever fall in. The sand is raised alternately with each flapper, as with a large ladle, until it has accumulated behind her, when supporting herself with her head and fore part on the ground fronting her body, she with a spring from each flapper sends the sand around her, scattering it to the distance of several feet. In this manner the hole is dug to the depth of eighteen inches, or sometimes more than two feet. This labour I have seen performed in the short period of nine minutes. The eggs are then dropped one by one, and disposed in regular layers, to the number of a hundred and fifty, or sometimes nearly two hundred. The whole time spent in this part of the operation may be about twenty minutes. She now scrapes the loose sand back over the eggs, and so levels and smooths the surface that few persons on seeing the spot could imagine any thing had been done to it. This accomplished to her mind, she retreats to the water with all possible dispatch, leaving the hatching of the eggs to the heat of the sand. When a turtle, a loggerhead for example, is in the act of dropping her eggs, she will not move although one should go up to her, or even seat himself on her back, for it seems that at this moment she finds it necessary to proceed at all events, and is unable to intermit her labour. The moment it is finished, however, off she starts; nor would it then be possible for one, unless he were as strong as a Hercules, to turn her over and secure her.

"To upset a turtle on the shore, one is obliged to fall on his knees, and, placing his shoulder behind her forearm, gradually raise her up by pushing with great force, and then with a jerk throw her over. Sometimes it requires the united strength of several men to accomplish this; and if the turtle should be of very great size, as often happens on that coast, even hand-spikes are employed. Some turtlers are so daring as to swim up to them while lying asleep on the surface of the water, and turn them over in their own element, when, however, a boat must be at hand to enable them to secure their prize. Few turtles can bite beyond the reach of their forelegs, and few, when once turned over, can without assistance regain their natural position; but notwithstanding this, their flappers are generally secured by ropes, so as to render their escape impossible.

"Persons who search for turtles' eggs are provided with a light stiff cane or gun-rod, with which they go along the shores, probing the sand near the tracks of the animals, which, however, cannot always be seen, on account of the winds and heavy rains that often obliterate them. The nests are discovered not only by men, but also by beasts of prey, and the eggs are collected, or destroyed on the spot in great numbers, as on certain parts of the shores hundreds of turtles are known to deposit their eggs within the space of a mile. They form a new hole each time they lay, and the second is generally dug near the first, as if the animal were quite unconscious of what had befallen it. It will be readily understood that the numerous eggs seen in a turtle on cutting it up could not be all laid the same season. The whole number deposited by an individual in one summer may amount to four hundred, whereas if the animal is caught on or near her nest, as I have witnessed, the remaining eggs, all small, without shells, and as it were threaded like so many large beads, exceed three thousand. In an instance where I found that number, the turtle weighed nearly four hundred pounds. The young, soon after being hatched, and when yet scarcely larger than a dollar, scratch their way through their sandy covering, and immediately betake themselves to the water.

"The food of the green turtle consists chiefly of marine plants, more especially the grasswrack (*Zostera marina*), which they cut near the roots to procure the most tender and succulent parts. Their feeding grounds, as I have elsewhere said, are easily discovered by floating masses of these plants on the flats, or along the shores to which they resort. The hawk-billed species feeds on sea-weeds, crabs, various kinds of shell-fish, and fishes; the loggerhead mostly on the fish of conch-shells of large size, which they are enabled, by means of their powerful beak, to crush to pieces with apparently as much ease as a man cracks a walnut. One which was brought on board the Marion, and placed near the fluke of one of her anchors, made a deep indentation in that hammered piece of iron that quite surprised me. The trunk turtle feeds on mollusca, fish, crustacea, sea urchins, and various marine plants.

"All the species move through the water with surprising speed: but the green and hawk-billed in particular remind you, by their celerity and the ease of their motions, of the progress of a bird in the air. It is therefore no easy matter to strike one with a spear, and yet this is often done by an accomplished turtler. . .

with their hands only; and by this means they usually catch them both together. But sometimes the female escapes, being more shy than the male.

Another way of taking them is by the harpoon, either when they are playing on the surface of the water, or feeding at the bottom; when the harpoon is skilfully darted, it sticks fast in the shell of the back; the wood then disengages from the iron, and the line is long enough for the animal to take its range; for if the harpooner should attempt at once to draw the animal into his boat till it is weakened by its own struggling, it would probably get free. Thus the turtle struggles hard to get loose, but all in vain; for they take care the line fastened to the harpoon shall be strong enough to hold it.

There is yet another way, which, though seemingly awkward, is said to be attended with very great success. A good diver places himself at the head of the boat; and when the turtles are observed, which they sometimes are in great numbers, asleep on the surface, he immediately quits the vessel, at about fifty yards distance, and keeping still under water, directs his passage to where the turtle was seen, and, coming up beneath, seizes it by the tail; the animal awaking struggles to get free; and by this both are kept at the surface until the boat arrives to take them in.

"Turtles such as I have spoken of are caught in various ways on the coasts of the Floridas, or in estuaries and rivers. Some turtlers are in the habit of setting great nets across the entrance of streams, so as to answer the purpose either at the flow or at the ebb of the waters. These nets are formed of very large meshes, into which the turtles partially enter, when, the more they attempt to extricate themselves, the more they get entangled. Others harpoon them in the usual manner; but in my estimation no method is equal to that employed by Mr Egan, the pilot of Indian isle.

"That extraordinary turtler had an iron instrument, which he called a *peg*, and which at each end had a point not unlike what nail-makers call a brad, it being four-cornered but flattish, and of a shape somewhat resembling the beak of an ivory-billed woodpecker, together with a neck and shoulder. Between the two shoulders of this instrument a fine tough line, fifty or more fathoms in length, was fastened, by one end being passed through a hole in the centre of the peg, and the line itself was carefully coiled up and placed in a convenient part of the canoe. One extremity of this peg enters a sheath of iron that loosely attaches it to a long wooden spear, until a turtle has been pierced through the shell by the other extremity. He of the canoe paddles away as silently as possible whenever he spies a turtle basking on the water, until he gets within a distance of ten or twelve yards, when he throws the spear so as to hit the animal about the place which an entomologist would choose, were it a large insect, for pinning it to a piece of cork. As soon as the turtle is struck, the wooden handle separates from the peg, in consequence of the looseness of its attachment The smart of the wound urges on the animal as if distracted, and it appears that the longer the peg remains in its shell, the more firmly fastened it is, so great a pressure is exercised upon it by the shell of the turtle, which being suffered to run like a whale, soon becomes fatigued, and is secured by hauling in the line with great care. In this manner, as the pilot informed me, eight hundred green turtles were caught by one man in twelve months.

"Each turtler has his *crawl*, which is a square wooden building or pen, formed of logs, which are so far separated as to allow the tide to pass freely through and stand erect in the mud. The turtles are placed in this inclosure, fed and kept there until sold. If the animals thus confined have not laid their eggs previous to their seizure, they drop them in the water, so that they are lost.

"When I was in the Floridas, several turtlers assured me, that any turtle taken from the depositing ground, and carried on the deck of a vessel several hundred miles, would, if then let loose, certainly be met with at the same spot, either immediately after, or in the following breeding season. Should this prove true, and it certainly may, how much will be enhanced the belief of the student in the uniformity and solidity of Nature's arrangements, when he finds that the turtle, like a migratory bird, returns to the same locality, with perhaps a delight similar to that experienced by the traveller, who, after visiting distant countries, once more returns to the bosom of his cherished family!"

CHAP. IV.

OF THE SHELL OF TESTACEOUS FISHES.

One is apt to combine very dissimilar objects in the same group, when hurried into the vortex of method. No two animals are more unlike each other than the whale and the limpet, the tortoise and the oyster. Yet, as these animals must find some place in the picture of animated nature, it is best to let them rest in the station which the generality of mankind have assigned them; and as they have been willing to give them all from their abode the name of fishes, it is wisest in us to conform.

But before I enter into a history of shell-fish, it may not be improper to observe, that naturalists, who have treated on this part of history, have entirely attended to outward forms; and, as in many other instances, forsaking the description of the animal itself, have exhausted all their industry in describing the habitation. In consequence of this radical error, we have volumes written upon the subject of shells, and very little said on the history of shell-fish. The life of these industrious creatures, that, for the most part, creep along the bottom, or immovably wait till driven as the waves happen to direct, is almost entirely unknown. The wreathing of the shells, or the spots with which they are tinctured, have been described with a most disgusting prolixity; but their appetites and their combats, their escapes and humble arts of subsistence, have been utterly neglected.

As I have only undertaken to write the history of animated nature, the variety of

shells and their peculiar spots or blemishes, do not come within my design. However, the manner in which shells are formed is a part of natural history connected with my plan, as it presupposes vital force or industry in the animal that forms them.

The shell may be considered as a habitation supplied by nature. It is a hard stony substance, made up somewhat in the manner of a wall. Part of the stony substance the animal derives from outward objects, and the fluids of the animal itself furnish the cement. These united make that firm covering which shell-fish generally reside in till they die.

But, in order to give a more exact idea of the manner in which sea-shells are formed, we must have recourse to an animal that lives upon land, with the formation of whose shell we are best acquainted. This is the garden-snail, that carries its box upon its back, whose history Swammerdam has taken such endless pains to describe. As the manner of the formation of this animal's shell extends to that of all others that have shells, whether they live upon land or in the water, it will be proper to give it a place before we enter upon the history of testaceous fishes.

To begin with the animal in its earliest state, and trace the progress of its shell from the time it first appears—The instant the young snail leaves the egg, it carries its shell or its box on its back. It does not leave the egg till it is arrived at a certain growth, when its little habitation is sufficiently hardened. This beginning of the shell is not much bigger than a pin's head, but grows in a very rapid manner, having at first but two circumvolutions, for the rest are added as the snail grows larger. In proportion as the animal increases in size, the circumvolutions of the shell increase also, until the number of these volutes come to be five, which is never exceeded.

The part where the animal enlarges its shell is at the mouth, to which it adds in proportion as it finds itself stinted in its habitation below. Being about to enlarge its shell, it is seen with its little teeth biting and clearing away the scaly skin that grows at the edges. It is sometimes seen to eat those bits it thus takes off; at other times it only cleans away the margin when covered with films, and then adds another rim to its shell.

For the purposes of making the shell, which is natural to the animal, and without which it could not live three days, its whole body is furnished with glands, from the orifices of which flows out a kind of slimy fluid, like small spider threads, which join together in one common crust or surface, and in time condense and acquire a stony hardness. It is this slimy humour that grows into a membrane, and afterwards a stony skin; nor can it have escaped any who have observed the track of a snail; that glistening substance which it leaves on the floor or the wall, is no other than the materials with which the animal adds to its shell, or repairs it when broken.

Now to exhibit in a more satisfactory manner the method in which the shell is formed —The snail bursts from its egg with its shell upon its back; the shell, though very simple, is the centre round which every succeeding convolution of the shell is formed, by new circles added to the first. As the body of the snail can be extended no where but to the aperture, the mouth of the shell only can, of consequence, receive augmentation. The substance of which the shell is composed is chiefly supplied by the animal itself, and is no more than a slimy fluid which hardens into bone. This fluid passes through an infinite number of little glands, till it arrives at the pores of the skin; but there it is stopped by the shell that covers the part below; and therefore is sent to the mouth of the shell, where it is wanted for enlargement. There the first layer of slime soon hardens; and then another is added, which hardens also, till in time the shell becomes as thick as is requisite for the animal's preservation. Thus every shell may be considered as composed of a number of layers of slime, which have entirely proceeded from the animal's own body.

But though this be the general opinion with regard to the formation of shells, I cannot avoid thinking there are still other substances besides the animal's own slime which go to the composition of its shell, or at least to its external coat, which is ever different from the internal. The substances I mean are the accidental concretions of earthy or saline parts, which adhere to the slimy matter upon its first emission.[1] By adopting this theory, we can more satisfactorily account for the various colours of the shell, which cannot be supposed to take its tincture from the animal's body, as is the usual opinion; for all the internal parts of the shell are but of one white colour; it is only the outermost layer of the shell that is so beautifully varied, so richly tinctured with that variety of colours we behold in the cabinets of the curious. If the external coat be scaled off, as Mr Argenville asserts, all the inner substances will be found but of one simple colouring; and consequently the animal's own juices can give only one colour; whereas we see some shells stained with a hundred.

[1] Our author is mistaken in supposing that any part of the shell is composed of extraneous matter. If such were the case, the same species of shell would often be found to differ in its composition and external appearance, whereas some species are so uniformly alike, that it is difficult to distinguish between two shells.

The usual way of accounting for the different colouring of shells, which seems to me erroneous, is this; in the body of every one of these animals, several streaks are discerned of a different colour from the rest. "This variety," say they, "is an incontestable proof that the juices flowing from these parts will be also of a different hue; and will consequently tinge that part of the shell which their slime composes of a different colour." But this system, as was observed before, is overthrown by the fact, which discovers that only the outer surface of the shell is tinged; whereas by this it would have been coloured throughout; nay, by this system, the internal parts of the shell would be stained with the most vivid colouring, as being least exposed to the external injuries of the element where it is placed. But the truth is, the animal residing in the shell has none of these various colours thus talked of: its slime is a simple pellucid substance; and the only marblings which appear in its body, are the colour of the food, which is seen through its transparent intestines. We must, therefore, account for the various colouring of its shell upon a different principle.

If, as I said, we examine the cabinets of the curious, we shall find shells with various and beautiful colouring; we shall find them generally furnished with a white ground, tinctured with red, yellow, brown, green, and several other shades and lovely mixtures, but never blue. Shells are of almost all colours but blue. The reason seems to be obvious; for blue is the colour which sea-water changes. A piece of silk, or a feather, of this colour, put into an infusion of salt, urine, or nitre, lose their tint entirely. Now may not this give us a hint with respect to the operation of nature in colouring her shells? May we not from hence conclude, that sea-water is efficacious in giving colour, or taking it away? That, to produce colour, the animal not only furnishes its juices, but the sea or the earth that mixture of substance which is to unite with them? Neither the animal slime alone, nor the external earthy or saline substances alone, could produce colours; but both united, produce an effect which neither, separately, was possessed of. Thus shells assume every colour but blue; and that sea-water, instead of producing, would be apt to destroy.

From hence, therefore, it appears, that the animal does not alone tincture its own shell; but that external causes co-operate in contributing to its beauty. It is probable that, from the nature of its food, or from other circumstances unknown to us, the external layers of its slime may be of different consistences; so, as when joined with the particles of earth or salt that are accidentally united with them from without, they assume various and beautiful hues. But the internal layers, which receive no foreign admixture, still preserve the natural colour of the animal, and continue white without any variation.

Thus far we see that the animal is not wholly the agent in giving beauty and colouring to its shell: but it seems otherwise with respect to its convolutions, its prominences, and general form. These entirely depend upon the art of the animal; or rather upon its instincts; which, in the same kinds, are ever invariable. The shell generally bears some rude resemblance to the body upon which it has been moulded. Thus, it is observable in all sea-shells, that if the animal has any tumour, or excrescence on its body, it creates likewise a swelling in that part of the incrustation to which it corresponds. When the animal begins to alter its position, and to make new additions to its apartments, the same protuberance which had raised the shell before in one part, swells it again at some little distance; by which means we see the same inequality, in a spiral line, all round the shell. Sometimes these tumours of the animal are so large, or so pointed, that those which rise over them in the incrustation appear like horns: after this the animal disengages itself from its first cavities; and then, by fresh evacuations, assumes a new set of horns; and so increases the number in proportion to its growth. If, on the other hand, the body happens to be channelled, the shell that covers it will be channelled likewise; if there be any protuberances in the body, which wind in a spiral line about it, the shell will likewise have its tumours and cavities winding round to the end.

In this manner, as the animals are of various forms, the shells exhibit an equal variety. Indeed, the diversity is so great, and the figures and colours so very striking, that several persons, with a kind of harmless indolence, have made the arrangement of them the study and the business of their lives. Those who consult their beauty alone, take care to have them polished, and to have an external crust, or periosteum, as Swammerdam calls it, scoured off from their surfaces by spirit of salt. But there are others that, with more learned affectation, kept them exactly in the state in which they have been found, with their precious crust still round them. The expense men have sometimes been at, in making such collections, is amazing; and some shells, such as the Stairs-shell, or the Admiral-shell, are not more precious for their scarceness, than pearls are for their beauty. Indeed, it is the scarcity, and not the beauty of the object, that determines the value of all natural curiosities. Those shells that offer but

little beauty to the ignorant are often the most precious; and those shells which an unlearned spectator would stop to observe with admiration, one accustomed to the visitation of cabinets would pass over with disdain.—These collections, however, have their use; not only by exhibiting the vast variety of Nature's operations, but also by exciting our curiosity to the consideration of the animals that form them. A mind that can find innocent entertainment in these humble contemplations is well employed; and, as we say of children, is kept from doing mischief. Although there may be nobler occupations than that of considering the convolutions of a shell, yet there may be some who want the ambition to aspire after such arduous pursuits; there may be some unfit for them; there may be some who find their ambition fully gratified by the praise which the collectors of shells bestow upon each other. Indeed, for a day or two, there is no mind that a cabinet of shells cannot furnish with pleasing employment. "What can be more gratifying," as Pliny says,[1] "than to view nature in all her irregularities, and sporting in her variety of shells! Such a difference of colour do they exhibit! such a difference of figure! flat, concave, long, lunated, drawn round in a circle, the orbit cut in two! some are seen with a rising on the back, some smooth, some wrinkled, toothed, streaked, the point variously intorted, the mouth pointing like a dagger, folded back, bent inwards! all these variations, and many more, furnish at once novelty, elegance, and speculation."[2]

[1] Plin. ix. 33.

[2] *Conchology.*—Aristotle had three orders of Testacea,—Univalves, Bivalves and the Turbinated,—but the class itself and these divisions were loosely defined; and the same vagueness is to be found in the writings of those authors who followed his method. Perhaps Dr Walter Charleton, Physician in Ordinary to Charles II. was the first who had a full conviction of the importance of system, but his attempt to arrange the Mollusca is very faulty.* The Limaces he places with apodous insects; and aquatic animals being divided as usual into the sanguineous and exsanguineous, the remaining molluscas are arranged under two classes—viz. the *mollia* or *molluscula* and the *testacea*. The first embraces all the cuttles and the Lepus marinus or Aplysia; the second the shelled tribes, whose primary sections are the same as those of Aristotle's, while his genera, in general without definitions, rest on characters of little or no value. Jean-Daniel Major, Professor of Practical Medicine in the university of Keil, in the duchy of Holstein, was the next to make the attempt, (1675,) which is pronounced by two critics, to whose opinion much deference has been shown, to be "infinitely too complicated and ramifying to admit of any useful application." Sibbald, Grew, Bonanni, Lister, Langius, Hebenstreit, Tournefort, D'Argenville, and Klein are perhaps the principal who followed in their wake, but it is evident that they had all entered on their task without a previous study of what the real object and use of method

* Onomastikon Zoikon. Lond. 1671. 4to.

With respect to the figure of shells, Aristotle has divided them into three kinds: and his method is, of all others, the most conformable to nature. These are, first the *univalve*,

was, what principles were to guide them in framing the various sections, or what the relative bearing of these divisions on one another should be. The division of shells primarily into Multivalve, Bivalve, and Univalve had perhaps superseded the Aristotelian, and many new divisions of secondary rate were of course invented, but they were arbitrary, founded on no common principle, either too lax or too complex to be applicable in practice, cumbersome to the memory, and clumsy in writing. To analyse these methods would be wearisome and unprofitable,—they were next to useless when promulgated, and have now no attraction even in the eyes of the pure conchologist. It is when we rise from their examination that we are in the best mood to appreciate the merits of Linnæus

Linnæus having, with a tact characteristic of his genius for system, divided invertebrated animals into two great classes—*Insecta* and *Vermes*,—was less happy in his reduction of the latter into their secondary groups or orders. The testaceous mollusca occupy one order by themselves, in which there are four sections of equal value—the multivalve, bivalve (*Conchæ*,) the univalves with a regular spire (*Cochleæ*), and the univalves without a regular spire.† In each section there are several genera defined with neat precision,—the characters of the multivalves being derived from the position of the valves —of the bivalves from the number and structure of the hinge-teeth, or, in the absence of these, from a part influencing the opening of the valves,—of the Cochleæ from the unilocular or multilocular shell, but in most from the formation of the aperture; while in the last division the shape of the shell affords the means of discriminating them, excepting in Teredo, which is defined "T. intrusa ligno," in evident contrariety to his principles and his better custom. The naked tribes are placed in the order denominated "Mollusca," where they stand, in "admired disorder," with radiated zoophytes, annelidans, parasitical worms, and the Echinodermata, which latter, however, are better in this strange miscellany, than they were when they stood either amongst simple or multivalved shells.

In estimating the merits of this system it is not fair to look back from our present vantage ground, and magnify its defects by a comparison with modern classifications: we are in candour to place ourselves behind its author, and looking forward, say how far his efforts have been useful or quickening.‡ Standing thus we trust to offend none of his admirers when we admit that there is nothing in its principle of a novel character: the soft mollusca were previously recognized and better assorted by Charleton; and every one of the sections, and, if we mistake not, of the genera also, of the shelled tribes, had been already recognized. It labours under the censure of having too small regard to the animal, a censure in some degree just, for assuredly more was known of these than the definitions of the "Systema," would lead us to suppose; and it had still less regard to the position of the groups in reference to their organical affinities. It often associates species of dissimilar habits; and species are found in almost every genus at variance with the character of this, and where consequently the student ought not to have sought for them. The superiority of it lies in its simplicity; in the regulated subor-

† The expounders of Linnæus' system do not adopt this last division,—why, it is difficult to say. By disregarding it they have injured the naturalness of the method.

‡ The first edition of the 'Systema Naturæ,' was published in 1735, but 1758 is properly the year which gave birth to his conchological system, when the tenth edition was published. It was perfected in 1766.

or *turbinated*, which consists of one piece, like the box of a snail; secondly, the *bivalve*, consisting of two pieces, united by a hinge, like an oyster; and, thirdly, the *multivalve*, consisting of more than two pieces, as the Acorn-shell, which has not less than twelve pieces that go to its composition. All these kinds are found in the sea at different depths, and

dination of all its parts; in the admirable sagacity with which the families or genera are limited; in the assumption of more stable characters for these, and for the clear distinct manner in which they are applied; in the suitableness of its nomenclature; in the invention of trivial names which give a facility in writing hitherto unknown, and was a welcome relief to the memory; in the conciseness of the specific characters and the skill with which those characters were chosen; in the regular indication of the stations which the species occupy on the globe; and in the beauty of the more extended descriptions, and the peculiar felicity of language in which the thoughts suggested by any remarkable structure in the species under review are conveyed to us. That merits of this kind should secure him something more than approbation was natural: there was much excellence in it which prejudice or jealousy only could not see, and which folly alone would have rejected; and while every collector and amateur found it easy to be understood, ready in practice, and neat in nomenclaturing their cabinets, their pursuit assumed the garb of science when they could tell the scorner that they were following the steps, and had the sanction, of a man whose genius has justly won him a place in the first rank of those whom succeeding ages continue to venerate for the good they have done in the promotion of useful knowledge.

While the eyes of almost all were turned to this northern luminary for light to guide them in their pursuit, or as an object by barking at which a few drew notice on their littleness, Jussieu of Paris, the admirer of Linnæus' genius and industry, and his correspondent, was explaining to his select but few disciples the principles of what has been commonly called the "Natural System." Jussieu's profound studies were confined to botany, but he had colleagues and contemporaries who attempted their application to conchology, and whose want of success is to be ascribed mainly to the meagreness of the anatomy of the mollusca then attained, to the fewness of the observations made on the living species, and in part also to the imperfection of the views of the authors. Daubenton, the colleague of Buffon, so early as 1743, insisted on a knowledge of the animal as necessary to form a natural classification of shells; and in 1756, Guttard, who was the personal friend of Jussieu, not only gave his sanction to this opinion, but showed its practicability and excellence by defining, from the peculiarities of the animal and shell combined, a considerable number of the univalves, comprehending among these, in evident agreement with their relations, though contrary to general use, the slugs, the Aplysia, and the Bullæa. But the fullest attempt of this kind was made by Adanson, whose work on Senegal was published some years before Linnæus had given the last revision to his system. Impelled by an indomitable enthusiasm, Adanson visited Senegal, under many disadvantages, to examine and describe the natural productions of a tropical climate; and for this purpose he made very extensive collections in every department of nature, but of his great work the first volume only, containing the outline of his travels and his account of the shells, was ever given to the people. The character of this volume has risen with the progress of the science, and it is more valued by the conchologists of the present day than it was by the contemporaries of its author. He had some personal peculiarities—too visible in his writings—which could not fail to hurt his popularity: an austere temperament, which caused him to treat his fellow-labourers with contemptuous acerbity,—a mind that would neither bend to nor treat with respect the prejudices, as he deemed them, of his age,—an unflinching severity in criticising the writings of others, and a pertinacious tenacity of his own views,—while some barbarisms he attempted to introduce into the nomenclature of conchology repelled the naturalists of a too nice taste, and the very extent of his requirements from those who claimed to be naturalists operated against him, for it was not to be supposed that mere collectors or virtuosos were to enter on so difficult a path, or would be willing to allow themselves to be pushed aside as idlers, and put without the pale of the scientific circle. Shell-fish were, according to him, distinguishable, in the first place, into "Limaçons" and "Conques;" the former were subdivided into univalves and operculated univalves, and the conques into bivalves and multivalves; these primary families were still further divided into smaller groups from the position of the eyes in the Limaçons, and from the figure of the respiratory tubes in the Conques. Now it was a pure arbitrariness in him to fix upon the operculum as a part or organ of primary value, for there is nothing in its use or position to justify the choice, nor did he attempt, by any analysis, to show that it was a regulator of structure and habits; and it was equally arbitrary to divide the bivalves into two sections on the mere existence of a few additional pieces over the hinge, for these pieces were not proved to be an index to the animal's economy. But Adanson's services to conchology are very great,—of those of its labourers who have passed in review we place him next to Lister. He has the merit of having altogether removed from the Testacea the Lepas and Balani, whose structure he saw was modelled after the type of another category; his interesting discovery of the Vermetus was a fine illustration of the shell being of itself useless as a character in natural history; and his knowledge of affinities was made evident by the acuteness which led him to approximate the Teredo to the Pholas. If not the first to point out the importance of the operculum, he was undoubtedly the first who knew its value as an index to natural relationship between genera; perhaps the first who was fully aware that the entireness or canaliculate formation of the aperture of the shell gave an insight into the habits of the snail in regard to food; the first too to point out fully the influence of age and sex in altering the shape of the shell, and more especially of its aperture; the first to describe and delineate the animal tenant of many genera; and although his attention was exclusively directed to external characters, yet we are above all indebted to him for his strong advocacy of the maxim that the anatomy of the animal was the sole sure foundation of a rational arrangement which had in view the mutual affinities of the objects it attempted to classify, and present them not fancifully commixed as they might be placed in a museum, but according to those characters which nature itself had given them of affinity or dissemblance.

The example of Adanson was followed by Geoffroy who, in a history of the shells found in the vicinity of Paris, attempted to arrange them on the external anatomy of their animals; and by Muller, who described in the same manner the mollusca of the north of Europe. The writings of Muller are still deservedly held in high estimation. They contain the descriptions of many novelties, and his descriptions of them, as well as of species previously known, are remarkable for their accuracy; they are thickly strewed with notices of the external anatomy and habits of those he had examined alive; and his style of writing is interesting, rising occasionally to eloquence. As an observer and teller of what he had observed, he claims a place among the first,

are valuable in proportion to their scarceness or beauty.

From the variety of the colours and figures of shells, we may pass to that of their place and situation. Some are found in the sea; some in fresh-water rivers; some alive upon land; and a still greater quantity dead in the bowels of the earth. But wherever shells

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but he was the discoverer of no fact in their structure or physiology of any consequence—we speak in reference to the mollusca only; and his systematic efforts were limited and partial, although he sometimes drops a hint on the subject, which makes us almost believe that he was capable of better things, had he had courage to have made the attempt. In relation to the mollusca, he clearly saw the impropriety of making the presence or absence of the shell an ordinal character; and he knew, vaguely it may be, the affinity between the bivalvular mollusca and the Tunicata.

The celebrated Pallas was another who at this period had obtained a glimpse of the true relations of the mollusca as a class even clearer than Muller, but he did not pursue the subject, and as his slight incidental notice, though it might have originated inquiry in a predisposed mind, was not otherwise of a nature to produce any effect, so the pains of Geoffroy and Muller were equally unproductive. The authority of Linnæus prevailed every where. The force of his genius having swept away all previous systems, there was no other safety for a naturalist, than to take refuge in the Linnæan ark, which floated on the surface proud amid the ruins, —the systems of his contemporaries also sinking one after another in the waters of forgetfulness. His disciples were distinguished by their enthusiasm in the pursuit of nature, and their love of their master; and the facility with which they found their discoveries were registered, and the easy nature of the discoveries which sufficed to give them a certain reputation, requiring nought but zeal, opportunity, and a knowledge of the 'Systema' not difficult to be acquired, rivetted their attachments. In England nothing was tolerated that was not according to the letter of Linnæus: his works were a code of laws which, like an act of Parliament, was to be interpreted verbally, and the spirit of them was unseen or overlooked. Under his reforming hand, Conchology having passed 'from confusion and incongruity to lucid order and simplicity,' the slightest attempt to alter this order was treated as an attempt to replunge us into the chaos, whence he had brought us, and further improvement or alteration was declared to be futile, since the 'beauties' of the Linnæan 'must perpetuate its pre-eminence.' Were it shewn that, from the very subsidiary station the animal was made to occupy in this system, there was a fear attention should be drawn from the object most worthy of it, we were seriously told that the animal, even could it be procured, which was doubtful, would never present those 'permanent and obvious points of distinction' indispensable in the application of a system meant to be practical. Wherein does the animal differ, it was asked in a tone of triumph, signifying that reply was impossible,—'wherein does the animal differ from an unshapen mass of lifeless matter when coiled up within its shelly habitation? And how are its natural shape and appendages to be examined, but by the knife of an anatomist?' Were it proved, what indeed was most palpable, that species of opposite habits and habitations were huddled together under a common head, it was answered that to derive characters from such particulars was contrary to axiom and unphilosophical; and if it were demonstrative that the class of Testacea, as a whole, was constituted of heterogeneous disparates,—as for example, when Pallas indicated the difference between this class and the Serpulæ,—what then? Nature gloried in variety and oppositions, and was herself systemless, as if it were possible to believe that He who made every thing in wisdom and order had shook His creatures from his hand, with the same wanton unordered profusion that the poet has represented the jocund May, flinging the flowerets from her teeming lap. Such were the futile reasons by which this System was upheld, and so firm was its despotism that, until within these twenty years, there was little or no relaxation on its hold of public opinion; and its evil effects are too evident in the superficialness of the productions which emanated from this school.

Even in France the Linnæan system soon became little less predominant under the leading of Bruguiere, but the regard the French paid to it was of a less slavish character than it had assumed in Britain. Bruguiere, though a Linnæan in principle, carried forward in some degree the system of his master by intercalating several new and obviously necessary genera; and he was otherwise a conchologist of higher attainments than any England could at that period boast of. He cannot be said to have promoted conchology in any very sensible degree, but he made no effort to arrest it, or detain the science at the stage where Linnæus had left it. Nor indeed is it perhaps possible to stop the march of any, however trivial the branch of science, to perfection. Like the operations of Nature in her living productions ever tending to maturity, there are periods of acceleration and delay, and causes may for a season induce a sickly weakness that waits long for a remedy, but come at last this will. Conchology was now in her sickly time,—nevertheless in a state of constant advancement. Ellis, Baster, Bohadtch, Pallas, Muller, Forskal, Solander, and Otho Fabricius, all of whom might have seen Linnæus in the flesh, and were his immediate successors, drew attention to the naked molluscans in particular, whose curious variety was enticing and provocative to further quest; Herissant, Scopoli, Bruguiere, and Olivi, described many species with their animals, and entered too into physiological questions which it was worthy reasonable men to solve; Knorr, Davila, Martini and Chemnitz, Schroter, Born, Pennant, Da Costa, and Martyn, set forth at intervals volumes of figures more numerous in species and more correct than had been hitherto attempted; and the minute or microscopic species, which notwithstanding their littleness have played a most important part in the revolutions of our globe, were well illustrated in the works of Soldani, Plancus, Boys and Walker, and of Fichtel and Moll. Yet this array of names only proves a wider spread of the study, —the students may have been, and we think were, mediocrists,—many of them were simply ichniographists and collectors.* We can remember no discovery by which to distinguish the period, for the developement or improvement of an artificial system, the accumulation of species, and their more accurate discrimination, though points of considerable importance, are not sufficiently so to mark an era. Perhaps the most curious and interesting discovery that was made in it is that of the capability of the snail to reproduce its tentacula, eyes, and head, when these have been cut off,—the phenomena of which singular reintegration were amply elucidated by the experiments of Spallanzani, Bonnet, and others.

* It is most especially necessary to except from this remark John Hunter, but his labours and views were not published, and were not appreciated. 'John Hunter was a great discoverer in his own science; but one who well knew him has told us, that few of his contemporaries perceived the ultimate object of his pursuits; and his strong and solitary genius laboured to perfect his designs without the solace of sympathy, without one cheering approbation.'—D'Israeli's Literary Character, Vol. i. p 146. See Abernethy's Physiological Lectures p. 193, for a list of the Mollusca anatomized and exhibited in Hunter' Museum; also p. 217, 263.

are found, they are universally known to be composed of one and the same substance. They are formed of an animal or calcareous earth, that ferments with vinegar and other acids, and that burns into lime, and will not easily melt into glass. Such is the substance of which they are composed; and of their spoils, many philosophers think that a great

The first to raise us from this enchained slumber was Cuvier. Before this great naturalist entered the field, Poli, a Neapolitan physician, had indeed anatomized with admirable skill the bivalved mollusca of his native shores, and had constructed a new arrangement of them from the characters of the animal alone, but partly from the political position of Europe, partly from the very expensive fashion in which Poli's work was published, and its consequent extremely limited circulation, and in part also from the partial application of his system and its didactic character, the erroneousness of his general views, and the novelty of his nomenclature,—we cannot trace its influence either as diffusive or propulsive of conchology. The result of Cuvier's labours was happily very different. In 1788,-when he was scarcely nineteen years of age, circumstances fixed Cuvier for a time at Caen in Normandy. His sojourn on the borders of the sea induced him, already an enthusiast in natural history, to study marine animals, more especially the mollusca, and the anatomies of them which he now made conducted him to the developement of his great views on the whole of the animal kingdom. With unwearied zeal he collected the materials which were at no distant date to become the basis of a classification which ran through all its details in a harmonious parallelism with the developement of organization, so that the student of it, when in search of the name and place of the object in his hand, was necessitated simultaneously to acquire a knowledge of its principal structural peculiarities, on which, again, as Cuvier beautifully explained, all its habits in relation to food, to habitation, and to locomotion, were made dependant. The Linnæan system of avertebrated animals, even in its primary sections, rested on a single external character. The Insecta were *antennulated*, and the Vermes were *tentaculated* avertebrates. Had the character been constant or even general, it might have had some claim for adoption, but to a want of constancy was added the fundamental defect of its inappreciable influence over the organisms of the body. Cuvier's object being to give us not merely a key to the name, but to make that key open at the same time a knowledge of the structure and relations of the creature, such arbitrary assumption of a character was to him useless. After innumerable dissections had made him familiar with many structures, and after a careful consideration of the respective value of characters, as shown in their constancy and influence on the economy of the species, Cuvier resolved to divide the animal kingdom, not as hitherto into two, but into four principal sub-kingdoms, drawing their lines of separation from differences exhibited in the plan on which their muscular, their nervous, and their circulating systems were formed. "There exist in nature," he says, "*four* principal forms, or general plans, according to which all animals seem to have been modelled, and the ulterior divisions of which, whatever name the naturalists may apply to them, are but comparatively slight modifications, founded on developement or addition of certain parts, which do not change the essence of the plan." Of these forms the mollusca furnish the second, of which the essential character is derived from the peculiar arrangement of the nervous system, consisting of some ganglions scattered as it were irregularly through the body, and from each of which nerves radiate to its various organs. As there is no skeleton, so the muscles are attached to the skin, which forms a soft contractile envelope protected, in many species, by a shell. The greater number possess the senses of taste and sight, but the last is often wanting. "Only one family can boast of the organ of hearing; they have always a complete system of circulation, and organs peculiarly adapted to respiration; those of digestion and secretion are nearly as complicated as the same organs in vertebrated animals." The sub-kingdom, characterized and limited by those important features, is next divided into six classes, the characters of which are mostly derived from the organs of locomotion, or others not less influential. Thus the Cephalopodes bear their feet and arms like a coronet round the summit of the head; the Pteropodes swim in their native seas by fin-like oars; and the Gasteropodes crawl on the belly by means of a flat disk or sole. Reaching now tribes among whom the organs of motion are less developed, and accordingly less influential on their manners, Cuvier resorts to others. Thus the fourth class is named Acephalés, because it is strikingly distinguished by the want of head and amorphous form of its constituents; the Brachiopodes are equally acephalous, but near the mouth they have two fringed fleshy organs which simulate feet; and the Cirropodes have several pairs of subarticulated fringed feet, in addition to a multivalved shell of a peculiar construction. The orders of these classes, when the class admits of further subdivision, rest upon distinct differences in the structure and position of the branchiæ or respiratory organs; and when we reflect a moment on the paramount necessity of these to the animal, and their necessary co-adaptation to its locality and wants, it is scarcely possible to conceive that a happier choice could have been made.*

Early in 1799, Lamarck published his *Prodromus* of a new classification of shells, laying down, more precisely, the generic characters, and establishing many new genera, and still continuing the old division into *univalves*, *bivalves*, and *multivalves*. Up to this time, Lamarck does not seem to have profited much by the labours of his predecessors towards the establishment of a natural conchyliological method, but acknowledges that he has adopted the principles and views of Bruguiére. Late in 1799, Cuvier published a table of the divisions of the class of *mollusca*, at the end of the first volume of his Lessons of Comparative Anatomy. We see, in this, that Cuvier derived light from the *Prodromus* of Lamarck. Indeed, these two great naturalists, by their successive works, seem to have afforded light alternately to each other for a number of years. In 1801, Lamarck published his *Animaux sans Vertèbres*, in which, not confining himself entirely to the shells, he has, like Cuvier, paid atttention also to the animals. From this period until 1822, when he finished publishing the second edition of *Animaux sans Vertèbres*, under the title of *Histoire naturelle des Animaux sans Vertèbres*, many authors, both continental and British, had published memoirs and treatises on conchology, and many interesting facts had been collected, shedding much additional light on the science. Part of the 5th and the whole of the 6th and 7th volumes of the *Histoire naturelle des Animaux sans Vertèbres*, are devoted to the conchyliophorous animals, the proper subjects of conchology. In this excellent work, Lamarck has improved upon the views of his friend Bruguiére in the following particulars:—not confining himself to the consideration of the shell; viewing the shell as forming part of an animal; introducing into conchology a great number of new generic groups; using a very rigorous and exact terminology;

* For the above sketch of the different systems of conchology, we are indebted to an elaborate article on the History of Conchology, in the *Magazine of Zoology and Botany*, Edinburgh. 1838. Vol. II.

part of the surface of the earth is composed at present. It is supposed by them, that chalks, marls, and all such earths as ferment with vinegar, are nothing more than a composition of shells, decayed, and crumbled down to one uniform mass.

Sea-shells are either found in the depths of the ocean, or they are cast empty, and forsaken

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and treating as the foundation of the principal division among bivalves, the number of the muscular impressions. He has also abandoned the divisions, multivalves, bivalves, and univalves, which had been followed by most of the preceding conchologists, and has increased the number of genera to 261.

Synoptical Table of the Generic Characters of Lamarck's Conchological System; arranged according to the descending scale; with some additional genera, distinguished by an asterisk.

CLASS I.—MOLLUSCA UNIVALVES.

ORDER. I.—HETEROPODA.

Having a head; two eyes; no arms; body free; swims horizontally; destitute of a foot; fins, but irregular.
Phytliroe and *Pterotrachea*, destitute of shells.
Carnaria, *Cymbium*, pl. 31. fig. 1.

ORDER II.—CEPHALOPODA.

DIVISION I.—CEPHALOPODA SEPIARIA.

FAMILY I.—AMMONACEA.

Mantle bag-shaped; head protruding from the bag, with inarticulate arms, having suckers around the mouths; two eyes; mouth with horny mandibles.
The genera are *Sepia*, *Loligo*, *Loligopsis*, and *Octopus*, all destitute of shells.

DIVISION II.—CEPHALOPODA MONOTHALAMA.

Argonauta Argo, pl. 31, fig. 2.

DIVISION III.—CEPHALOPODA POLYTHALAMA.

FAMILY I.—AMMONACEA.

Baculites, *Turrilites*, *Ammonoceras*, *Orbulites*, and *Ammonites*, are fossil.

FAMILY II.—NAUTILACEA.

Nautilus pompilius, pl. 31. fig. 3. *Nummulites*, *Vorticialis*, *Polystomella*, *Siderolites*, and *Discorbis*, are fossil.

FAMILY III.—RADIOLACEA.

Placentula, *Lenticulina*, and *Rotalia*, fossil.

FAMILY IV.—SPHERULACEA.

Melonia, fossil. *Miliola concentrica*.

FAMILY V.—CRISTACEA.

Orbiculina, *Cristellarea*, and *Renulina*, principally fossil.

FAMILY VI.—LITUOLACEA.

Lituola and *Spirolina*, fossil. *Spirula Peronii*, pl. 31. fig. 4.

FAMILY VII.—ORTHOCERATA.

Conilites and *Hippurites*, fossil. *Nodosaria radicula*, pl. 31, fig. 5. *Orthocera raphanus*, fig. 5. *Belemnites*, fossil.

ORDER III.—TRACHELIPODA.

SECTION I.—ZOOPHAGOUS TRACHELIPODA.

Body of the animal spirally convolute posteriorly, separated from the foot; shell spiral enveloping the animal. This order is divided into three sections.

FAMILY I.—INVOLUTA.

Conus betulinus, pl. 31, fig. 6. *Oliva utriculus*, f. 7. *Ancillaria glandiformis*, f. 8. *Terebellum subulatum*, f. 9. *Cypræa Lynx*. f. 10. *Ovula verrucosa*, f. 11.

FAMILY II.—COLUMELLARIA.

Volvaria cylindrica, pl. 31, fig. 12. *Marginella bivaricostata*, f. 13. *Voluta scapha*, f. 14. *Mitra tæneata*, f. 15. *Columbella rustica*, f. 16.

FAMILY III.—PURPURIFERA.

Terebra vittata, pl. 31. fig. 17. *Eburna spirata*, f. 18. *Buccinum lineolatum*, f. 19. *Dolium tesselatum*, f. 20. *Harpa nobilis*, f. 21. *Concholepas Peruvianus*, f. 22. *Monoceros glabratum*, f. 23. *Purpura bicostalis*, f. 24. *Recinula arachnoides*, f. 25. *Cassis areola*, f. 26. *Cassidaria echinophora*, f. 27.

FAMILY IV.—ALATA.

Strombus succinctus, pl. 31. fig. 28. *Pterocera millepeda*, f. 29. *Rostellaria columbina*, f. 30.

FAMILY V.—CANALIFERA.

Triton scorbiculator, pl. 31. fig. 31. *Murex acanthopterus*, f. 32. *Ranella granulata*, f. 33. *Struthiolaria nodulosa*, f. 34. *Fyrula reticulata*, f. 35. *Fusus longicaudata*, f. 36. *Fasciolaria tulipa*, f. 37. *Cancellaria asperella*, f. 38. *Turbinella scolymus*, f. 39. *Pleurotoma Babylonia* f. 40. *Cerithium aluco*, f. 41.

SECTION II.—PHYTOPHAGA.

FAMILY I.—TURBINACEA.

Turitella duplicata, pl. 31. fig. 42. *Phasianella varia*, f. 43. *Planaxis undulata*, f. 44. *Turbo smaragdus*, f. 45. *Monodonta canalifera*, f. 46. *Trochus papillosus*, f. 47. *Rotella vestrarius*, f. 48. *Solarium variegatum*, f. 49.

FAMILY II.—SCALARIDES.

Delphinula laciniata, pl. 31. fig. 50. *Scalaria coronata*, f. 51. *Vermetus lumbricalis*, f. 52.

FAMILY III.—PLICACEA.

Pyramidella maculosa, pl. 31. fig. 53. *Tornatella flammea*, f. 54.

FAMILY IV.—MACROSTOMA.

Haliotis tuberculata, pl. 31. fig. 55. *Stomatia phymotis*, f. 56. *Stomatella auricula*, f. 57. *Sigaretus haliotoideus*, f. 58. *Galericulum lævi jatum*. fig. 111.

FAMILY V.—IANTHINIA.

Ianthina exigua, pl. 31. fig. 59.

FAMILY VI.—NERITACEA.

Natica stercus-muscarum, pl. 31. fig. 60. *Nerita peloronta*, f. 61. **Neritoides littoralis*, f. 112. *Neritina punctulata*, f. 62. *Navicella tesselaria*, f. 63.

FAMILY VII.—PERISTOMIDA.

Ampullaria rugosa, pl. 31. fig. 64. *Paludina vivipara*, f. 65. *Valvata depressa*, f. 66. *Pirena Madagascarensis*, f. 67. *Melanopsis costata*, f. 68. *Melania granifera*, f. 69.

FAMILY IX.—LYMNÆACEA.

Lymnæa auricularia, pl. 31. fig. 70. *Physa hypnorum*, f. 71. *Planorbis corneus*, f. 72.

FAMILY X.—COLIMACEA.

Cyclostoma bistriatus, pl. 31. fig. 73. *Auricula felis*, f. 74. *Succinea amphibia*, f. 75. *Achatina perdix*, f. 76. *Bulimus-radiatus*, f. 77. *Clausilia ventricosa*, f. 78. *Pupa unidentata*, f. 79. *Helicina major*, f. 80. *Anastoma globosa*, f. 81. *Carocolla Madagascarensis*, f. 82. *Helix nemoralis*, f. 83.

ORDER IV.—GASTEROPODA.

Body always straight, never enveloped in a shell which can entirely contain it; foot situated under the abdomen, united to the body nearly its whole length.

of their animals, upon shore. Those which are fished up from the deep, are called by the Latin name *Pelagii*; those that are cast upon shore are called *Littorales*. Many of the pelagii are never seen upon shore; they continue in the depths where they are bred; and we owe their capture only to accident. These, therefore, are the most scarce shells,

FAMILY I.—LIMACINEA.

Vitrina elongata, pl. 31. fig. 84. *Testacella Haliotoidea*, f. 85. *Limax rufus*, f. 86. *Parmacella Olivieri*, f. 87. *Onchidium*. Destitute of a shell. *P. Calyculata*, f. 108.

SECTION II.—HYDROBRANCHIÆ.

FAMILY II.—LAPLYSIACEA.

Dolabella callosa, pl. 31. fig. 88. *Laplysia radiata*, f. 89.

FAMILY III.—BULLACEA.

Bulla amygdala, pl. 31. fig. 90. *Bullæa catena*, f. 91. **Utriculus obtusa*, f. 110. **Akera flexilis*, f. 109. *Acera*. Destitute of a shell.

FAMILY IV.—CALYPTRACEA.

Ancylus fluviatilis, pl. 31. fig. 92. *Crepidula fornicata*, f. 93. *Calyptræa sinense*, f. 94. *Pileopsis Ungarica*, f. 95. *Fisurella Græca*, f. 96. **Sipho striata*, f. 113. *Emarginula fissura*, f. 97. *Parmophorus Australis*, f. 98.

FAMILY V.—SEMPHYLLIDIACEA.

Umbrella Indica, pl. 31. fig. 99. *Pleurobranchus plumula*, f. 100.

FAMILY VI.—PHYLLIDIACEA.

Patella vulgata, pl. 31. fig. 101. *Chiton marginatus*, f. 102. *Chitonellus striatus*, f. 103. *Phyllidia*. Destitute of a shell.

FAMILY VII.—TRITONIACEA.

Doris, *Tethys*, *Scyllæa*, *Titonia*, *Eolis*, and *Glaucus*. Destitute of shells.

ORDER V.—PTEROPODA.

Destitute of foot and arms; two opposite fins; body free. *Pneumodermon*. Shelless. *Cymbulia proboscidea*, pl. 31. fig. 104. *Limacina helicialis*, f. 105. *Cleodora pyramidata*, f. 106. *Clio*. Destitute of a shell. *Hyalæa cuspidata*, f. 107.

CLASS II.—CONCHIFERA. BIVALVES.

Animals soft, inarticulated, without head or eyes, and adhering to a bivalve shell; having external branchiæ, simple circulation, and a unilocular heart.

ORDER. I.—MONOMYARIA.

With one muscular attachment, and one subventral muscular impression.

SECTION I.—NO LIGAMENT.

FAMILY I.—BRACHIOPODA.

Lingula anatina, pl. 32. fig. 1. *Terebratula vitrea*, f. 3. *Orbicula Norwegica*, f. 2.

FAMILY II.—RUDISTA.

Crania striata, pl. 32. fig. 4. *Discina ostreoides*, f. 55. Gen. Birostritus, Calicola, Radiolites, and Sphærulites, fossil.

SECTION II.—LIGAMENT MARGINAL.

FAMILY I.—OSTRACEA.

Anomia Ephipphium, pl. 32. fig. 6. *Placuna sella*, f. 7. *Vulsella spongiarum*, f. 8. *Ostrea cornucopiæ*, f. 9. *Gryphæa secunda*, f. 10.

FAMILY II.—PECTINIDES.

Podopsis truncata, pl. 32. fig. 11. *Spondylus spatuliformis*, f. 12. *Plicatula cristata*, f. 13. *Pecten radula*, f. 14. *Phlagiostoma semilunaris*, f. 15. *Lima fragilis*, f. 16. *Pedum spondyloideum*, f. 17.

SECTION III.—LIGAMENT ELONGATED AND MARGINAL.

FAMILY I.—MALLEACEA.

Meleagrina margaritifera, pl. 32. fig. 18. *Avicula obliqua*, f. 19. *Malleus vulgaris*, f. 20. *Perna isognomum*, f. 21. *Crenatula phasianoptera*, f. 22.

FAMILY II.—MYTILACEA.

Pinna elegans, pl. 32. fig. 23. *Mytilus Afer*, f. 24. *Modiola papuana*, f. 25.

FAMILY III.—TRIDACNITES.

Hippopus maculatus, pl. 32. fig. 26. *Tridacna squamosa*, f. 27.

ORDER II.—DIMYARIA.

Muscular impressions two, separate and lateral.

SECTION I.—IRREGULAR AND ALWAYS INEQUIVALVE.

FAMILY I.—CAMACEA.

Etheria elliptica, pl. 32. fig. 28. *Chama arcinella*, f. 29. *Diceras arietina*, f. 30.

SECTION II.—LAMELLIPEDES.

FAMILY I.—NAYADES.

Inhabit fresh water. *Iridina exotica*, pl. 32. fig. 31. *Anadonta cygnea*, f. 32. *Hyria corrugata*, f. 33. *Unio irroratus*, f. 34.

FAMILY II.—TRIGONACEA.

Castalia ambigua, pl. 32. fig. 35. *Trigonia scabra*, f. 36.

FAMILY III.—ARCACEA.

Nucula tenuis, pl. 32. fig. 37. *Pectunculus pilosus*, f. 38. *Arca tortuosa*, f. 39. *Cucullæa auriculifera*, f. 40.

FAMILY IV.—CARDIACEA.

Isocardia Moltkiana, pl. 32. fig. 41. *Hiatella arctica*, f. 42. *Cypricardia coralliophaga*, f. 43. *Cardita crassicosta*, f. 44. *Cardium elongatum*, f. 45.

FAMILY V.—CONCHACEA.

Venericardia imbricata, pl. 32. fig. 46. **Ortygia sulcata*, f. 47. *Venus verrucosa*, f. 48. *Cytherea erycina*, f. 49. **Exoleta lincta*, f. 50. *Cyprina Islandica*, f. 51. **Lasæa rubra*, f. 52. *Galathea radiata*, f. 53. *Cyrena fuscata*, f. 54. *Cyclas cornea*, f. 55. **Pisidium obliqua*, f. 56.

SECTION III.—TENUIPEDES.

FAMILY I.—NYMPHACEA.

Crassina sulcata, pl. 32. fig. 57. *Capsa Braziliensis*, f. 58. *Donax denticulata*, f. 59. *Lucina carnaria*, f. 60. **Mysia rotundata*, f. 61. *Corbis lamellosa*, f. 62. **Arcopagia crassa*, f. 63. *Tellinides roseus*, f. 64. *Tellina punicea*, f. 65. *Psammotæa variegata*, f. 66. *Psammobia vespertina*, f. 67. *Sanguinolaria Occidens*, f. 68.

FAMILY II.—LITHOPHAGI.

Venerupis irus, pl. 32. fig. 69. *Petricola Pholadiformis*, f. 70. *Saxicava Præcisa*, f. 71.

FAMILY III.—CORBULACEA.

Pandora rostrata, pl. 32. fig. 72. *Corbula sulcata*, f. 73.

FAMILY IV.—MACTRACÆA.

Amphidesma Lucinalis, pl. 32. fig. 74. *Solemya Mediterranea*, f. 75. **Tellimya suborbicularis*, f. 76. *Ungulina transversa*, f. 77. *Erycina striata*, f. 78. *Crassatella Kingicola*, f. 79. **Ligula tenuis*, f. 80. **Mactrina triangula-*

and consequently the most valuable. The litorales are more frequent, and such as are of the same kind with the pelagii are not so beautiful. As they are often empty and forsaken, and as their animal is dead, and, perhaps, putrid in the bottom of the shell, they, by this means, lose the whiteness and the brilliancy of their colouring. They are not, unfrequently

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ris, f. 81. *Matra Stultorum*, f. 1. *Lutraria compressa*, f. 2.

SECTION IV.—Crassipedes.

Posterior margin gaping.

Family I.—Myaria.

Anatina convexa, pl. 33. fig. 3. *Mya arenaria*, f. 4. **Galeomma Turtoni*, f. 5. **Magdala striata*, f. 6. **Myatella striata*, f. 7. **Crenella elliptica*, f. 8. **Spenia Binghami*, f. 9.

Family II.—Solenides.

Glycimeris Siliqua, pl. 33. fig. 10. *Panopea Aldrovandi*, f. 11. *Solen Vagina*, f. 12.

Family III.—Pholadaria.

Gastrochæna modiolina, pl. 33. fig. 13. *Pholas dactylus*, f. 14.

Family IV.—Tubicola.

Teredo navalis, pl. 33. fig. 15; 16, side valve; 17, one of the bivalves; 18, section of interior part of the tube. *Teredina personata*, f. 19. *Septaria arenaria*, f. 20. *Fistulana clava*, f. 21. Fig. 22. a side valve. *Clavagella aperta*, f. 23. Fig. 24 a face valve. *Aspergillum Javanum*, f. 25.

CLASS III.—CIRRIPEDA.

Animals soft, destitute of head or eyes, covered with an adhering shell.

ORDER. I.—PEDUNCULATA.

Body supported on a tubular peduncle.

Otion Cuvieri, pl. 33. fig. 26. *Cineras vittata*, f. 27. *Pollicipes mitella*, f. 28. **Scalpellum vulgare*, f. 29. *Anatifa vitrea*, f. 30.

ORDER II.—Sessilia.

Body inclosed in a multivalve shell which is seated on rocks or marine bodies; mouth and tentacula in the opening of the shell; operculated.

Pyrgoma crenata, pl. 33. fig. 31. *Creusia verruca*, f. 32. *Acasta Montagui*, f. 33. **Adna Anglica*, f. 34. *Balanus Cranchii*, f. 36. *Coronula testudinaria*, f. 37. *Tubicinilla balænarum*, f. 38.

Division III.—Articulata.

CLASS V.—Annelides.

Elongated, soft, consisting of segments; having red blood.

ORDER I.—Sedentareæ.

Animals placed in a testaceous tube, in which they ever live; branchiæ at one extremity of the body.

Family I.—Serpulacea.

Magilus antiquus, pl. 33. fig 39. *Galeolaria recumbens*, f. 40. *Vermilia triquetra*, f. 41. *Serpula tubularia*, f. 42. *Spirorbis spirillum*, f. 43.

Family II.—Amphitritæa.

Amphitrite ventilabrum, pl. 33. fig. 44. *Terebella conchilega*, f. 45. *Sabellaria crassissima*, f. 46. *Pectinaria Belgica*, f. 47.

Family III.—Maldaniæ.

Dentalium entalis, pl. 33. fig. 48. *Brochus reticulatus*, f. 49. *Cornuoides minor*, f. 50. *Clymene*.

Family IV.—Dorsaliæ.

Siliquaria anguina, pl. 33. fig. 51. *Arnicola*. Destitute of shell.

EXPLANATION OF THE PARTS OF SHELLS.

OF THE OPERCULA OF UNIVALVE SHELLS.

The opening, or aperture of many univalve shells, is covered, when the animal is withdrawn within, by an operculum or lid, intended for the protection of the inhabitant. This is attached to the foot of the animal, and is either of a horny substance, or is testaceous, being as hard as the shell itself. This appendage will be familiar to all who have seen the common periwinkle, which is abundant on most rocky shores. Its texture is of a horny nature.

Operculum of Nerita Undulata, pl. 33. fig. 52. Phasianella Bulimoides, 53. Trochus Pharaonis, 54. Melania Byronensis, 55. Neritia fluviatilis, 56. Panludina achatina, 57. Turbo Pica, 58. Neritoides littoralis, 59. Murex Brandaris, 60. Buccinum undatum, 61. Strombus Auris-Dianæ, 62. Trochus littoralis, 63.

Animal of the *Monodonta Pica* 64. *a*, the tentacula, or feelers; *b*, the trunk; *cc*, the pedicles, with the eyes at their tips; *dd*, the branchiæ or gills; *ee*, mantle; *f*, foot; *g*, the operculum; *h*, the tail, or that extremity of the animal which occupies the volutions at the tip of the shell.

The following are the shells figured, explanatory of the different parts:—Fig. 65, Fusus antiquus; 66, Voluta vespertilio; 67, A lusus naturæ of Helix Pomatia; 68, Spirula Peronii; 69, Cassis ariola; 70, Cypræa exanthema; 71, Clausilia ventricosa; 72, Planorbis Planata; 73, Crepidula aculeata; 74, Fusus discrepans; 75, Dolium galea; 76, Turitella terebra; 76,* Helix Umbilicata; 77, Cytherea Chione; 78, Hinge of Lutraria elliptica; 79, Solen truncatus; 80, Cardium elongatum; 81, Spondylus gæderopus; 82, Anomia squamula; 83, Cardium edule; 84, Venus Cassina; 85, Pecten obsoletus; 86, Pholas candidus; 87, Anatifa striata; 88, Balanus communis; 89, Operculum of Balanus Cranchii; 90, Chiton cinereus.

Apex, is the summit or tip of the spire, pl. 33. fig. 65—*a*.

Base, the opposite extremity to the apex, pl. 33. fig. 65—*b*. In simple univalves, such as the patellæ, it is the margin of the aperture, the tip of the vertex being the apex. Example of the base in a depressed shell, pl. 33. fig. 72—*b*.

Body. The lower volution of the shell in which the aperture is placed, pl. 33 fig. 65—*m*, *m*, *m*.

Front, is the place where the aperture is situated.

Back, the opposite of the front, opposed to that in which the aperture is situated.

Venter, the most bulging part of the front, pl. 33. fig. 65—*c*.

Sides, the extreme edges of the shell, pl. 33. fig. 65—*dd*. Right is the opposite to that in which the aperture is situated.

Aperture, the mouth or opening—*g*.

Beak, the elongated process at the base of many genera of univalves, pl. 33. fig. 65. *i*, f. 75—*c*.

Canal, the inside of the beak, pl. 33. fig. 65. *h*, 75—*b*.

Pillar or *columella*, is that process which runs through the spire, for the support of the volutions, f. 76—*a*, *a*.

Platted columella, is when there are folds at the base of the pillar lip, f. 66—*a*.

Pillar lip, a continuation of the enamelled process which lines the inside of the shell, and is reflected on the base of the pillar: this also is termed the *inner lip*, pl. 33. fig. 65—*k*.

Outer lip, the expansion of the body of the shell or outer edge of the aperture, pl. 33. fig. 65—*l*.

Spire, is the whole volutions of the shell but the lower one, pl. 33. fig. 65—*e*, *e*, *e*. The remaining or lower one is the body, as above noticed.

Crowned or *coronated spire*, f. 66—*b*, *b*, *b*.

Whorl, is one of the volutions, or turnings of the spire,

Depressed spire, is when the spire is partly flattened, or entirely so, as exemplified in the shells of the genus planorbis, pl. 33. fig. 72—*a*.

also found eaten through, either by worms, or by each other; and they are thus rendered less valuable; but what decreases their price still more is, when they are scaled and worn by lying too long empty at the bottom, or exposed upon the shore. Upon the whole, however, sea-shells exceed either land or fossil-shells in beauty; they receive the highest

Involuted spire. Those univalve shells which have their volutions concealed inside of the body of the shell, as in the Nautili and Cypræa, pl. 33. fig. 70.

Reversed or *Heterostrophe spire*, is when the volutions of the spire revolve in a contrary direction to that of a common screw; in which case the aperture is on the right side, in place of the left, which is the case with all dextral shells, pl. 33. fig. 71.

Detached spire, is when the volutions are not adhering together at their base, pl. 33. fig. 67.

Suture of the spire a fine thread-like line, which runs spirally between the volutions, pl. 33. fig. 65—*f, f, f, f, f.*

Sides, are the extreme edges of the shell, when the back or front is held next the observer, *d, d.*

Chambers, are the intervals, between the partitions or septa, of multilocular shells, pl. 33. fig. 68—*bb*, &c., and also occur in simple univalves, f. 73.

Siphuncle is the tube which extends through some of the multilocular univalves, pl. 33. fig. 68—*a.*

Septa, are partitions which divide the chambers in multilocular shells, f. 68—*c*, *c*, &c.

Varices, are transverse ribs which cross the volutions in some species of Murex, Triton, Buccinum, Cassis, &c., f. 69—*aa.*

Ribs, longitudinal and transverse projections, f. 75—*a a*; an example of the former; those in f. 74 illustrate the latter.

Teeth, some projecting laminæ in the aperture of univalves as represented in the aperture of pl. 33. fig. 71.

Umbilicus, a perforation in the base of the body, of Helices, Trochi, &c., pl. 33. fig. 76*—*a.*

PARTS OF BIVALVES.

Equilateral Shells, are those whose sides are alike, that is, both of a uniform size and shape, pl. 33, fig. 85.

Inequilateral Shells, have unequal sides, and of different shapes, as in Donox Lutraria, &c., pl. 33, fig. 77.

Summit, is the most elevated part of the shell, in which the hinge is usually situated, pl. 33, fig. 77—*a.*

Base, the opposite extremity of the above, pl. 33, fig. 77—*b.*

Anterior slope, is that side of the shell in which the ligament is situated, pl. 33, fig. 77—*d.*

Posterior slope. The opposite of the above, and may be distinguished by viewing the shell in front, when the beaks point to the observer, pl. 33, fig. 77—*e.*

Disk, the most prominent part of a valve, if lying with its inside undermost.

Cicatrix, the internal impression by which the animal was affixed to the shell, pl. 33, fig. 77—*gg, f* 80; *d*, f. 81—*e.*

Lunule, the crescent-shaped depressions, in the posterior and anterior slopes, pl. 33, fig. 77—*h.*

Ligament perforation, the circular aperture through which the ligament passes, as exemplified in the Anomiæ, pl. 33, fig. 82—*a.*

Hinge, that part by which the shells are united. It is generally constructed of teeth; those of the one valve fitting into a socket in the opposite one. Some shells have no teeth, but are merely kept together by the ligament, in which case they are called *inarticulate*; when they have many teeth, they are called *multiarticulate.* The *Hinge* is that part which affords the most prominent generic distinction in bivalves.

Teeth of the hinge. The number, relative situation, and construction of these, afford the best specific distinctions in bivalves. A spatuliform central tooth is exhibited, pl. 33, fig. 78.

Primary teeth, are those situated in the centre of the hinge. They are also termed the *cardinal teeth*, pl. 33, fig. 77—*i.*

Lateral teeth, are those divergent from the *umbo;* are usually long, flat, and frequently double, or divided by a groove, pl. 33. fig. 80—*a a.*

Double teeth. When teeth are very deeply cleft they are so termed.

Incurved teeth, are those which are bent round, as in the Spondylus Gæderopus, Solen Siliqua, &c., pl. 33. fig. 79.—*c.*

Recurved teeth, such teeth as are bent backwards are so termed, as in the hinge of the Panopea Aldrovandi, pl. 33. fig. 11; f. 81—*a a.*

Numerous teeth, are generally set in rows, either straight or curved as in pl. 32. fig. 37, 38, 39.

Cavity of the hinge, is a pit or hollow in which the ligament is inserted in the *Ostrea*, &c., as may be seen in pl. 32. fig. 20.

Ligament, is that cartilaginous substance by which the valves are held together, and is situated under the hinge of the shell, pl. 33. fig. 77—*k;* f. 80—*b.* The cavity in which it is inserted, f. 81—*b;* f. 83—*b.*

Beak, the extreme point or summit of bivalves, which, for the most part, is turned aside, or downwards, so that it is seldom the highest part of the bivalve.

Umbo, that part situated immediately under the beak, pl. 33. fig. 84—*a.*

Ears or *Auricles*, are those processes, situated on one or both sides of the beak, as in the scallops, pl. 33. fig. 81—*c c. Superior ear*, 85—*a. Inferior ear*, *b.*

Margin, the extreme edges of the entire shell.

Crenulated margin. When the margin is notched as in the common edible cockle it is so termed, pl. 33. fig. 80—*c c.*

Striæ, are fine thread-like lines, which traverse the exterior surface of shells, as exemplified, pl. 32. fig. 62, 63.

Spines, are exterior acutely pointed protrusions, composed of shelly matter, pl. 33. fig. 81—*d d.*

Right valve, may be distinguished by the anterior slope, pointing to the right hand, when the valve is viewed with the inside uppermost, pl. 32. fig. 46—the under valve, in many species, is flattened, as in the ostrea.

Left valve, the opposite of the above, or where the anterior slope points to the left hand, pl. 32. fig. 46.

Length of the shell—is always understood to be from that part in which the ligament is situated to the opposite extremity. Bivalve shells are called *longitudinal*, when their greatest length is from the hinge to the opposite margin, pl. 33. fig. 80 and 85, from *a* to *b*; and *transverse*, when their breadth exceeds their length —fig. 77 from *c* to *c;* and fig. 79 from *a* to *a.*

Byssus, or *beard.* An accessory filamentary appendage of a silky texture, by which some bivalve shells are affixed to rocks, stones, &c. as may be instanced in the common muscle. *Sides*—the right and left parts of the valves; pl. 33. fig. 77—*c, c.*

Ribs are longitudinal or transverse protuberances, generally running parallel to each other on the external surface of bivalves. *Longitudinal ribs*, pl. 33. fig. 83—*a. Transverse ribs*, f. 84.

Accessory valves are small, unattached valves in the genus Pholas, pl. 33. fig. 86.—*a.*

Valves of Chitons are placed transversely along the back of the animal, usually eight in number, pl. 33. fig. 90—*a, a*, &c. Fig. 91, a central valve; 92, a terminating valve.

Margin in Chitons, is a fleshy border which surrounds the valves, pl. 33. fig. 90—*b.*

PARTS OF CIRRIPEDES.—Multivalves.

Operculum—consists of from two to four small valves, placed in the opening at top of the *Balani*, pl. 33. fig. 88—*a;* f. 89.

Base—the part by which the shells of the genus Balanus, &c. are attached to rocks, pl. 33. fig. 87—*c;* f. 88—*b.*

Ligament—a membranous substance, by which the valves are attached, pl. 33. fig. 87—*d.*

Ridges—are convexities in the Balani, &c., sometimes longitudinal and at others transverse.

polish, and exhibit the most brilliant and various colouring.

Fresh-water shells are neither so numerous, so various, nor so beautiful, as those belonging to the sea. They want that solidity which the others have; their *clavicle*, as it is called, is neither so prominent nor so strong; and not having a saline substance to tinge the surface of the shell, the colours are obscure. In fresh-water there are but two kinds of shells, namely, the bivalved and the turbinated.

Living land-shells are more beautiful, though not so various, as those of fresh water; and some not inferior to sea-shells in beauty. They are, indeed, but of one kind, namely, the turbinated; but in that there are found four or five very beautiful varieties.

Of fossil, or, as they are called, *extraneous* shells, found in the bowels of the earth, there are great numbers, and as great a variety. In this class there are as many kinds as in the sea itself. There are found the turbinated, the bivalve, and the multivalve kinds; and of all these, many, at present, are not to be found even in the ocean. Indeed, the number is so great, and the varieties so many, that it was long the opinion of naturalists, that they were merely the capricious productions of nature, and had never given retreat to animals whose habitations they resembled. They were found, not only of various kinds, but in different states of preservation; some had the shell entire composed, as in its primitive state, of a white calcareous earth, and filled with earth, or even empty; others were found with the shell entire, but filled with a substance which was petrified by time; others, and these in great numbers, were found with the shell entirely mouldered away, but the petrified substance that filled it still exhibiting the figure of the shell; others still, that had been lodged near earth or stone, impressed their print upon these substances, and left the impression, though they themselves were decayed: lastly, some shells were found half mouldered away, their parts scaling off from each other in the same order in which they were originally formed. However, these different stages of the shell, and even their fermenting with acids, were at first insufficient to convince those who had before assigned them a different origin. They were still considered as accidentally and sportively formed, and deposited in the various repositories where they were found, but no way appertaining to any part of animated nature. This put succeeding inquirers upon more minute researches; and they soon began to find, that often, where they dug up petrified shells or teeth, they could discover the petrified remains of some other bony parts of the body. They found that the shells, which were taken from the earth, exhibited the usual defects and mischances which the same kind are known to receive at sea. They showed them not only tinctured with a salt-water crust, but pierced in a peculiar manner by the sea-worms, that make the shells of fishes their favourite food. These demonstrations were sufficient, at last, to convince all but a few philosophers, who died away, and whose erroneous systems died with them.

Every shell, therefore, wherever it is found, is now considered as the spoil of some animal, that once found shelter therein. It matters not by what unaccountable means they may have wandered from the sea; but they exhibit all, and the most certain marks of their origin. From their numbers and situation we are led to conjecture, that the sea reached the places where they are found; and from their varieties we learn how little we know of all the sea contains at present; as the earth furnishes many kinds which our most exact and industrious shell-collectors have not been able to fish up from the deep. It is most probable that thousands of different forms still remain at the bottom unknown; so that we may justly say with the philosopher, *Ea quæ scimus sunt pars minima eorum quæ ignoramus.*

It is well, however, for mankind, that the defect of our knowledge on this subject is, of all parts of learning, that which may be most easily dispensed with. An increase in the number of shells would throw but very few lights upon the history of the animals that inhabit them.[1] For such information we are

Peduncle, or *pedicle*—a sort of stem, or hollow membranaceous tube, on which the Anatifæ are seated, pl. 33. fig. 87—*b*.

Feelers, or *tentacula*—are those arms by which the animals of the Balani and Anatifæ secure their food, pl. 33. fig. 87—*a*.—(See a description of *Fossil* Mollusca at p. 25, Vol. I.)

[1] *Uses and Value of Shells.*—The greater part of the lime used in America for agricultural and architectural purposes, is made of calcined shells: the public streets of Christianstadt and Santa Cruz are paved with the Strombus Gigas; and the town of Conchylion is entirely built of marine shells. The blue and white belts of the Indians of North America, as symbols of peace and amity, in opposition to the war hatchet, and by which the fate of nations is often decided, are made of the Venus Mercenaria; and the gorget of the chieftain's war-dress is formed of the Mytilus Margaritiferus. The military horn of many African tribes is the Murex Tritonis; the rare variety of which, with the volutions reversed, is held sacred, and only used by the high priests. The highest order of dignity among the Friendly Islands, is the permission to wear the Cypræa Aurantium, or orange cowry. And Lister relates that the inhabitants of the province of Nicaragua fasten the Ostrea Virginica to a handle of wood, and use it as a spade to dig up the ground. As matter of traffic, they bear a nominal value and appreciation proportionate to their supposed scarcity or beauty. Rumphius is said to have given nearly a thousand pounds for one of the first discovered specimens of the Venus Dione. The Conus Cedo nulli, so very rarely offered for sale, is valued at three hundred

obliged to those men who contemplated something more than the outside of the objects before them. To Reaumur we are obliged for examining the manners of some with accuracy; but to Swammerdam for more. In fact, this Dutchman has lent an attention to those animals that almost exceeds credibility; he has excelled even the insects he dissected, in patience, industry, and perseverance. It was in vain that this poor man's father dissuaded him from what the world considered as a barren pursuit: it was in vain that an habitual disorder, brought on by his application, interrupted his efforts; it was in vain that mankind treated him with ridicule while living, as they suffered his works to remain long unprinted and neglected when dead: still the Dutch philosopher went on, peeping into unwholesome ditches, wading through fens, dissecting spiders, and enumerating the blood-vessels of a snail: like the bee, whose heart he could not only distinguish, but dissect, he seemed instinctively impelled by his ruling passion, although he found nothing but ingratitude from man, and though his industry was apparently becoming fatal to himself. From him I will take some of the leading features in the history of those animals which breed in shells; previously taking my division from Aristotle, who, as was said above, divides them into three classes: the Turbinated, or those of the Snail-kind; the Bivalved, or those of the Oyster-kind; and the Multivalved, or those of the Acorn-shell kind. Of each I will treat in distinct chapters.

CHAP. V.

OF TURBINATED SHELL-FISH, OR THE SNAIL KIND.

To conceive the manner in which those animals subsist that are hid from us at the bottom of the deep, we must again have recourse to one of a similar nature and formation that we know. The history of the garden-snail[1] has been more copiously considered than that

guineas. The Turbo Scalaris, if large and perfect, is worth a hundred guineas; the Cypræa Aurantium, without a hole beaten through it, is worth fifty; and it has been calculated, that a complete collection of the British Conchology is worth its weight in pure silver. In an economical and political view, they are of no inconsiderable import. Pearls, the diseased excrescences of mussels and oysters, form a portion of the revenues of these and some other kingdoms; and constitute, with jewels, the rich and costly ornaments by which the high and wealthy ranks of polished society are distinguished. The Cypræa Moneta, or money cowry, forms the current coin of many nations of India and Africa; and this covering or coat of an inconsiderable worm, stands at this day as the medium of barter for the liberty of man; a certain weight of them being given in exchange for a slave. The scholar needs not the reminiscence, that the suffrages of the ancient Athenians were delivered in, marked upon a shell; the record of which is still commemorated in the derivation of our terms, *testament* and *attestation*.

[1] *Garden Snails* —The most common in this country of herbivorous Trachelipods, is the Garden-snail; but the species whose history has been most copiously related, is that called in France the *Escargot*, which, though stated to have been originally imported into this country, now abounds in some parts of Surrey, and other southern countries. On the continent, especially in France, this large snail, which is more than double the size of our garden one, is used as an article of food, and though said not to be easy of digestion, is very palatable. They are thought to be in best season in the winter, when they are invested with their temporary calcareous covering, which falls off in the spring.

Early in the spring, snails lay, at different times, a great number of white eggs, varying at each laying from twenty-five to eighty, as large as little peas, enveloped in a membraneous shell, which cracks when dried. They lay these eggs in shady and moist places, in hollows which they excavate with their foot, and afterwards, cover with the same organ. These eggs are hatched sooner or later, according to the temperature, producing little snails, exactly resembling their parent, but so delicate that a sun-stroke destroys them, and animals feed upon them; so that few, comparatively speaking, reach the end of the first year, when they are sufficiently defended by the hardness of their shell.

The animal, at first, lives solely on the pellicle of the egg from which it was produced. This pellicle, consisting of carbonate of lime, united to animal substance, is necessary to produce the calcareous secretion of the mantle, and to consolidate the shell, as yet too soft for exposure. When this envelope is eaten, the little snail finds its nutriment, more or less, in the vegetable soil around it, and from which it continues to derive materials for the growth and consolidation of the shell. It remains thus concealed for more than a month, when it first issues forth into the world, and attacks the vegetable productions around, returning often to an earthly aliment, probably still necessary, for the due growth and hardening of its portable house.

These snails cease feeding when the first chills of autumn are felt; and associating, in considerable numbers, on hillocks, the banks of ditches, or in thickets and hedges, set about their preparations for their winter retreat. They first expel the contents of their intestines, and then concealing themselves under moss, grass, or dead leaves, each forms, by means of its foot, and the viscid mucus which it secretes, a cavity large enough to contain its shell. The mode in which it effects this is remarkable: collecting a considerable quantity of the mucus on the sole of its foot, a portion of earth and dead leaves adheres to it, which it shakes off on one side; a second portion is again thus selected and deposited, and so on till it has reared around itself a kind of wall of sufficient height to form a cavity that will contain its shell; by turning itself round it presses against the sides and renders them smooth and firm. The dome, or covering, is formed in the same way: earth is collected on the foot, which then is turned upwards, and throws it off by exuding fresh mucus; and this is repeated till a perfect roof is formed. Having now completed its winter-house, it draws in its foot, covering it with the mantle, and opens its spiracle to draw in the air. On closing this, it forms with its slime a fine membrane, interposed between the mantle and extraneous substances. Soon afterwards, the mantle secretes a large portion of very white fluid over its whole surface, which instantly sets uniformly,

of the elephant; and its anatomy is as well, if not better, known: however, not to give any one object more room in the general picture of nature than it is entitled to, it will be sufficient to observe that the snail is surprisingly fitted for the life it is formed to lead. It is furnished with the organs of life in a manner almost as complete as the largest animal: with a tongue, brain, salival ducts, glands, nerves, stomach, and intestines; liver, heart, and blood-vessels: besides this, it has a purple bag that furnishes a red matter to different parts of the body, together with strong muscles that hold it to the shell, and which are hardened, like tendons, at their insertion.

But these it possesses in common with other animals. We must now see what it has peculiar to itself. The first striking peculiarity is, that the animal has got its eyes on the points of its largest horns. When the snail is in motion, four horns are distinctly seen: but the two uppermost, and longest, deserve peculiar consideration, both on account of the various motions with which they are endued, as well as their having their eyes fixed at the extreme ends of them. These appear like two blackish points at their ends. When considered as taken out of the body, they are of a bulbous or turnip-like figure; they have but one coat; and the three humours which are common in the eyes of other animals, namely, the vitreous, the aqueous, and the crystalline, are, in these, very indistinctly seen. The eyes the animal can direct to different objects at pleasure, by a regular motion out of the body; and sometimes it hides them by a very swift contraction into the belly. Under the small horns is the animal's mouth; and though it may appear too soft a substance to be furnished with teeth, yet it has not less than eight of them, with which it devours leaves, and other substances, seemingly harder than itself; and with which it sometimes bites off pieces of its own shell.

But what is most surprising in the formation of this animal are the parts that serve for generation. Every snail is at once male and female; and while it impregnates another, is itself impregnated in turn. The vessels supplying the fluid for this purpose, are placed chiefly in the fore part of the neck, and extend themselves over the body; but the male and female organs of generation are always found united, and growing together. There is a large opening on the right side of the neck, which serves for very different purposes. As a vent, it gives a passage to the excrements; as a mouth, it serves for an opening for respiration; and also as an organ of generation, it dilates when the desire of propagation begins. Within this each animal has those parts, or something similar thereto, which continue the kind.

For some days before coition, the snails gather together, and lie quite near to each other, eating very little in the meantime; but they settle their bodies in such a posture, that the neck and head are placed upright. In the meantime, the apertures on the side of the neck being greatly dilated, two organs, resembling intestines, are seen issuing from them, which some have thought to be the instruments of generation. Beside the protrusion of these, each animal is possessed of another peculiarity; for, from the same aperture, they launch forth a kind of dart at each other, which is pretty hard, barbed, and ending in a very sharp point. This is performed when the apertures approach each other; and then

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and forms a kind of solid operculum about half a line in thickness, which accurately closes the mouth. When this is become hard, the animal separates the mantle from it. After a time, expelling a portion of the air it had inspired, and thus being reduced in bulk, it retreats a little further into the shell, and forms another leaf of mucus, and continues repeating this operation till there are sometimes five or six of these leaves forming cells filled with air between it and the operculum.

The mode in which these animals escape from their winter confinement is singular. The air they had expired on retiring into their shell further and further remains between the different partitions of mucous membrane above mentioned, which forms so many cells hermetically sealed: this they again inspire, and thus acquiring fresh vigour, each separate partition, as they proceed, is broken by the pressure of the foot, projected in part through the mantle; when arrived at the operculum, they burst it by a strong effort, and finally detaching it, then emerge, begin to walk, and to break their long fast.

In all these proceedings, the superintending care and wise provisions of a Father Being are evident. This creature can neither foresee the degree of cold to which it may be exposed in its state of hybernation, nor know by what means it may secure itself from the fatal effects it would produce upon it, if not provided against. But at a destined period,—at the bidding of some secret power, it sets about erecting its winter dwelling, and employing its foot both as a shovel to make its mortar, as a hod to transport it, and a trowel to spread it duly and evenly, at length finishes and covers in its snug and warm retreat; and then, still further to secure itself from the action of the atmosphere, with the slimy secretion with which its Maker has gifted it, fixes partition after partition, and fills each cell formed by it, with air, till it has retreated as far as it can from every closed orifice of its shell—and thus barricades itself against a frozen death. Again, in the spring, when the word is spoken —*Awake!*—it begins immediately to act with energy, it re-inspires the air stored in its cells, bursts all its cerements, returns to its summer-haunts, and again lays waste our gardens.

It is worthy of remark, that the terrestrial animals of this tribe all delight in shady and moist places, and that during hot and dry weather, they seldom make their appearance;—but no sooner comes a shower than they are all in motion. It is probable that their power of motion is impeded by a dry soil, and that the grains of earth and small stones, when quite dry, adhere to their slimy feet.—*Abridged from Kirby's Bridgewater Treatise.*

the one is seen to shoot its weapon, which is received by the other, though it sometimes falls to the ground; some minutes after, the snail which received the weapon, darts one of its own at its antagonist, which is received in like manner. They then softly approach still nearer, and apply their bodies one to the other, as closely as the palms and fingers of hands when grasped together. At that time the horns are seen variously moving in all directions; and this sometimes for three days together. The coupling of these animals is generally thrice repeated, at intervals of fifteen days each; and, at every time, a new dart is mutually emitted.

At the expiration of eighteen days, the snails produce their eggs, at the opening of the neck, and hide them in the earth with the greatest solicitude and industry. These eggs are in great numbers, round, white, and covered with a soft shell: they are also stuck to each other by an imperceptible slime, like a bunch of grapes, of about the size of a small pea.

When the animal leaves the egg, it is seen with a very small shell on its back, which has but one convolution; but in proportion as it grows, the shell increases in the number of its circles. The shell always receives its additions at the mouth, the first centre still remaining; the animal sending forth from its body that slime which hardens into a stony substance, and still is fashioned into similar volutions. The garden-snail seldom exceeds four rounds and a half; but some of the sea-snails arrive even at ten.

The snail, thus fitted with its box, which is light and firm, finds itself defended, in a very ample manner, from all external injury. Whenever it is invaded, it is but retiring into this fortress, and waiting patiently till the danger is over. Nor is it possessed only of a power of retreating into its shell, but of mending it when broken. Sometimes these animals are crushed seemingly to pieces, and, to all appearance, utterly destroyed; yet still they set themselves to work, and, in a few days, mend all their numerous breaches. The same substance by which the shell is originally made goes to the re-establishment of the ruined habitation. But all the junctures are very easily seen, for they have a fresher colour than the rest; and the whole shell, in some measure, resembles an old coat patched with new pieces. They are sometimes seen with eight or ten of these patches; so that the damage must have been apparently irreparable. Still, however, though the animal is possessed of the power of mending its shell, it cannot, when come to its full growth, make a new one. Swammerdam tried the experiment; he stripped a snail of its shell, without hurting any of the blood-vessels, retaining that part of the shell where the muscles were inserted; but it died in three days after it was stripped of its covering: not, however, without making efforts to build up a new shell; for, before its death it pressed out a certain membrane round the whole surface of its body. This membrane was entirely of the shelly nature, and was intended, by the animal, as a supply towards a new one.

As the snail is furnished with all the organs of life and sensation, it is not wonderful to see it very voracious. It chiefly subsists upon leaves of plants and trees; but is very delicate in its choice. When the animal moves to seek its food, it goes forward by means of that broad muscular skin which sometimes is seen projecting round the mouth of the shell; this is expanded before, and then contracted with a kind of undulating motion, like a man attempting to move himself forward by one arm while lying on his belly. But the snail has another advantage, by which it not only smooths and planes its way, but also can ascend in the most perpendicular direction. This is by that slimy substance with which it is so copiously furnished, and which it emits wherever it moves. Upon this slime, as upon a kind of carpet, it proceeds slowly along, without any danger of wounding its tender body against the asperities of the pavement; by means of this it moves upwards to its food upon the trees; and by this descends without danger of falling, and breaking its shell by the shock.

The appetite of these animals is very great; and the damage gardeners in particular sustain from them, makes them employ every method for their destruction. Salt will destroy them, as well as soot; but a tortoise in a garden is said to banish them much more effectually.

At the approach of winter, the snail buries itself in the earth; or retires to some hole, to continue in a torpid state, during the severity of the season. It is sometimes seen alone, but more frequently in company in its retreat; several being usually found together, apparently deprived of life and sensation. For the purposes of continuing in greater warmth and security, the snail forms a cover or lid to the mouth of its shell with its slime, which stops it up entirely, and thus protects it from every external danger. The matter of which the cover is composed, is whitish, somewhat like plaster, pretty hard and solid, yet, at the same time, porous and thin, to admit air, which the animal cannot live without. When the cover is formed too thick, the snail then breaks a little hole in it, which corrects the defect of that closeness, which proceeded from too much caution. In this manner, sheltered in its hole from the weather, defended in its shell by a

cover, it sleeps during the winter; and, for six or seven months, continues without food or motion, until the genial call of spring breaks its slumber, and excites its activity.

The snail, having slept for so long a season, wakes one of the first fine days of April, breaks open its cell, and sallies forth to seek for nourishment. It is not surprising that so long a fast should have thinned it, and rendered it very voracious. At first, therefore, it is not very difficult in the choice of its food; almost any vegetable that is green seems welcome; but the succulent plants of the garden are chiefly grateful; and the various kinds of pulse are, at some seasons, almost wholly destroyed by their numbers. So great is the multiplication of snails in some years, that gardeners imagine they burst from the earth. A wet season is generally favourable to their production; for this animal cannot bear very dry seasons, or dry places, as they cause too great a consumption of its slime, without plenty of which it cannot subsist in health and vigour.

Such are the most striking particulars in the history of this animal; and this may serve as a general picture, to which the manners and habitudes of the other tribes of this class may be compared and referred. These are, the sea-snail, of which naturalists have, from the apparent difference of their shells, mentioned fifteen kinds;[1] the fresh-water-snail, of which there are eight kinds; and the land-snail, of which there are five. These all bear a strong resemblance to the garden-snail, in the formation of their shell, in their hermaphrodite natures, in the slimy substance with which they are covered, in the formation of their intestines, and the disposition of the hole on the right side of the neck, which serves at once for the discharge of the fæces, for the lodging the instruments of generation, and for respiration, when the animal is under a necessity of taking in a new supply.

But, in nature, no two kinds of animals, however like each other in figure or conformation, are of manners entirely the same. Though the common garden-snail bears a very strong resemblance to that of fresh-water, and that of the sea, yet there are differences to be found, and those very considerable ones.

If we compare them with the fresh-water snail, though we shall find a general resemblance, yet there are one or two remarkable distinctions: and, first, the fresh-water snail, and, as I should suppose, all snails that live in water, are peculiarly furnished with a contrivance by Nature, for rising to the surface, or sinking to the bottom. The manner in which this is performed, is by opening and shutting the orifice on the right side of the neck, which is furnished with muscles for that purpose. The snail sometimes gathers this aperture into an oblong tube, and stretches or protends it above the surface of the water, in order to draw in or expel the air, as it finds occasion. This may not only be seen, but heard also by the noise which the snail makes in moving the water. By dilating this it rises; by compressing it the animal sinks to the bottom. This is effected somewhat in the manner in which little images of glass are made to rise or sink in the water, by pressing the air contained at the mouth of the tubes, so that it shall drive the water into their hollow bodies, which, before, were filled only with air, and thus make them heavier than the element in which they swim. In this manner does the fresh water snail dive or swim, by properly managing the air contained in its body.

But what renders these animals far more worthy of notice is, that they are viviparous, and bring forth their young not only alive, but with their shells upon their backs. This seems surprising; yet it is incontestably true: the young come to some degree of perfection in the womb of the parent; there they receive their stony coat; and from thence are excluded, with a complete apparatus for subsistence.

"On the twelfth of March," says Swammerdam, "I began my observations upon this snail, and collected a great number of the kind, which I put into a large basin filled with rain-water, and fed, for a long time, with potter's earth, dissolved in the water about them. On the thirteenth of the same month I opened one of these snails, when I found nine living snails in its womb: the largest of these were placed foremost, as the first candidates for exclusion. I put them into fresh-water, and they lived till the eighteenth of the same month, moving and swimming, like snails full grown: nay, their manner of swimming was much more beautiful." Thus, at whatever time of the year these snails are opened they are found pregnant with eggs, or with living snails; or with both together.

This striking difference between the fresh-water and the garden snail, obtains also in some of the sea kind: among which there are some that are found viviparous, while others lay eggs in the usual manner. Of this kind are one or two of the Buccinums; within which living young have been frequently found upon their dissection. In general, however, the rest of this numerous class bring forth eggs; from whence the animal bursts at a proper state of maturity, completely equipped with a house, which the moistness of the element where it resides does not prevent the in

[1] D'Argenville's Conchyliologie.

habitant from enlarging. How the soft slime of the snail hardens, at the bottom of the sea, into the stony substance of a shell, is not easy to conceive. This slime must at least be possessed of very powerful petrifying powers.

All animals of the snail kind, as was observed before, are hermaphrodites; each containing the instruments of generation double. But some of the sea kinds copulate in a different manner from those of the garden. The one impregnates the other; but, from the position of the parts, is incapable of being impregnated by the same in turn. For this reason it is necessary for a third to be admitted as a partner in this operation: so that, while one impregnates that before it, another does the same office by this; which is itself impregnated by a fourth. In this manner, Mr Adanson has seen vast numbers of sea-snails united together in a chain impregnating each other. The Bulin and the Coret perform the offices of male and female at the same time. The orifices in these are two, both separated from each other: the opening by which the animal performs the office of the male being at the origin of the horns; that by which it is passive, as the female, being farther down upon the neck. It may also be observed, as a general rule, that all animals that have this orifice, or verge, as some call it, on the right side, have their shells turned from the right to the left; on the contrary, those which have it on the left side, have their shells turned from left to right, in a contrary direction to the former.

But this is not the only difference between land and sea-snails. Many of the latter entirely want horns; and none of them have above two. Indeed, if the horns of snails be furnished with eyes, and if, as some are willing to think, the length of the horn, like the tube of a telescope, assists vision, these animals that chiefly reside in the gloomy bottom of the deep, can have no great occasion for them. Eyes would be unnecessary to creatures whose food is usually concealed in the darkest places; and who, possessed of very little motion, are obliged to grope for what they subsist on. To such, I say, eyes would rather be an obstruction than an advantage; and, perhaps, even those that live upon land are without them.

Those that have seen the shells of sea-snails, need not be told that the animal which produces them is larger than those of the same denomination upon land. The sea seems to have the property of enlarging the magnitude of all its inhabitants; and the same proportion that a trout bears to a shark, is often seen to obtain between a shell bred upon the land, and one bred in the ocean. Its convolutions are more numerous. The garden-snail has but five turns at the most; in the sea-snail the convolutions are sometimes seen amounting to ten.

There is a difference also in the position of the mouth in the garden and the water snail. In the former, the mouth is placed crosswise, as in quadrupeds; furnished with jaw-bones, lips, and teeth. In most of the sea-snails, the mouth is placed longitudinally in the head; and in some obliquely, or on one side. Others, of the Trochus kind, have no mouth whatsoever; but are furnished with a trunk, very long in some kinds, and shorter in others.

Snails of the Trochus kind, furnished thus with an instrument of offence, deserve our particular attention. The trunk of the Trochus is fleshy, muscular, supple, and hollow. Its extremity is bordered with a cartilage, and toothed like a saw. The snails that are provided with this may be considered as the predacious tribe among their fellows of the bottom. They are among snails what the tiger, the eagle, or the shark, is among beasts, birds, or fishes. The whole race of shelled animals avoid their approach; for their habitations, however powerfully and strongly built, though never so well fortified, yield to the superior force of these invaders. Though provided with a thick clumsy shell themselves, yet they move with greater swiftness at the bottom than most other shell-fish, and seize their prey with greater facility. No shell so large but they will boldly venture to attack; and, with their piercing auger-like trunk, will quickly bore it through. No efforts the other animal makes can avail: it expands itself, and rises to the surface; but the enemy rises with it: it again sinks to the bottom, but still its destroyer closely adheres. In this manner the carnivorous shell-fish, as some naturalists call it, sticks for several days, nay, weeks, to its prey, until, with its trunk, it has sucked out all the substance, or until it drops off, when the other begins to putrefy.

Thus it would seem, throughout nature, that no animal is so well defended but that others are found capable of breaking in upon its intrenchments. The garden-snail seems tolerably well guarded; but the wall of its shell is paper itself, in comparison with that which fortifies some of the sea-snail kind. Beside this thick shell, many of them are also furnished with a lid, which covers the mouth of the shell, and which opens and shuts at the animal's pleasure. When the creature hunts for food, it opens its box, gropes or swims about; and, when satisfied, drops its lid, and sinks to the bottom: there it might be supposed to remain in perfect security; but the trochus soon finds the way to break into the thickest part of its inclosure, and quickly destroys it with the most fatal industry.

The being liable to the attacks of the trochus

seems to be a calamity to which most of this tribe are subject. Scarce a shell is met with entire and sound to the end of its convolutions; but particularly the thinnest shells are the most subject to be thus invaded. As their shells are easily pierced, the predatory shell-fish, or the sea-worm, chiefly seek them for subsistence; and of those thin paper-like shells, not one in a hundred is found that has not suffered some disaster. As they are lighter than other shell-fish, they swim with greater ease; and this is the chief method of avoiding their heavier thick-shelled pursuers. The food of all snails properly lies at the bottom; when, therefore, the nautilus, or other thin-shelled fish, are seen busily swimming at the surface, it may be that, instead of sporting or sunning themselves, as some are apt to suppose, they are actually labouring to escape their most deadly pursuers.

Of all sea-snails, that which is most frequently seen swimming upon the surface, and whose shell is the thinnest, and most easily pierced, is the nautilus. Whether, upon these occasions, it is employed in escaping its numerous enemies at the bottom, or seeking for food at the surface, I will not venture to decide. It seems most probable, that the former is the cause of its frequently appearing; for, upon opening the stomach, it is found to contain chiefly that food which it finds at the bottom. This animal's industry, therefore, may be owing to its fears; and all those arts of sailing which it has taught mankind, may have been originally the product of necessity. But the nautilus is too famous not to demand a more ample description. Although there be several species of the nautilus, yet they all may be divided into two: the one with a white shell, as thin as paper, which it often is seen to quit, and again to resume; the other with a thicker shell, sometimes of a beautiful mother-of-pearl colour, and that quits its shell but rarely. This shell, outwardly, resembles that of a large snail, but is generally six or eight inches across; within it is divided into forty partitions, that communicate with each other by doors, if I may so call them, through which one could not thrust a goose-quill: almost the whole internal part of the shell is filled by the animal; the body of which, like its habitation, is divided into as many parts as there are chambers in its shell: all the parts of its body communicate with each other, through the doors or openings, by a long blood-vessel, which runs from the head to the tail. thus the body of the animal, if taken out of the shell, may be likened to a number of soft bits of flesh, of which there are forty, threaded upon a string. From this extraordinary conformation, one would not be apt to suppose that the nautilus sometimes quitted its shell, and returned to it again; yet nothing, though seemingly more impossible, is more certain. The manner by which it contrives to disengage every part of its body from so intricate a habitation, by which it makes a substance, to appearance as thick as one's wrist, pass through forty doors, each of which would scarcely admit a goose-quill, is not yet discovered: but the fact is certain; for the animal is often found without its shell; and the shell more frequently destitute of the animal. It is most probable, that it has a power of making the substance of one section of its body remove up into that which is next; and thus, by multiplied removals, it gets free.[1]

But this, though very strange, is not the peculiarity for which the nautilus has been the most distinguished. Its "spreading the thin oar," and "catching the flying gale," to use the poet's description of it, has chiefly excited human curiosity. These animals, particularly those of the white light kind, are chiefly found in the Mediterranean; and scarcely any who have sailed on that sea, but must often have seen them. When the sea is calm, they are observed floating on the surface; some spreading their little sail; some rowing with their feet, as if for life and death; and others still, floating upon their mouths, like a ship with the keel upward. If taken while thus employed, and examined, the extraordinary mechanism of their limbs for sailing will appear more manifest. The nautilus is furnished with eight feet, which issue near the mouth, and may as properly be called barbs: these are connected to each other by a thin skin, like that between the toes of a duck, but much thinner and more transparent. Of these eight feet thus connected, six are short, and these are held up as sails to catch the wind in sailing; the two others are longer, and are kept in the water,

[1] Goldsmith has confounded two shells very different in their characters. The one is an Argonauta, and the other a Nautilus. The paper argonaut is extremely thin, spiral, involute, membraneous, and unilocular, or consisting of a single apartment or cell. It has a narrow keel, bordered on each side by a row of conical sharp tubercles; its sides are nearly flat, with numerous angular waved ridges; its colour is white, with the keel often brown. The shell is very thin and brittle; from which circumstance it has obtained the name of paper nautilus. This shell is *the nautilus* of the ancients, mentioned in the writings of Pliny and others. It is supposed, that, in the early ages of society, the art of navigation owed its origin to the expert management of this instinctive sailor.

Learn of the little Nautilus to sail,
Spread the thin oar, and catch the driving gale.—*Pope.*

It swims on the surface of the sea, on the back of its shell, which exactly resembles the hull of a ship; it raises two feet like masts, and extends a membrane between, which serves as a sail; the other two feet are employed as oars. This fish is usually found in the Mediterranean.

serving like paddles to steer their course by. When the weather is quite calm, and the animal is pursued from below, it is then seen expanding only a part of its sail, and rowing with the rest: whenever it is interrupted, or fears danger from above, it instantly furls the sails, catches in all its oars, turns its shell mouth downward, and instantly sinks to the bottom. Sometimes also it is seen pumping the water from its leaking hulk; and, when unfit for sailing, deserts its shell entirely. The forsaken hulk is seen floating along, till it dashes, by a kind of shipwreck, upon the rocks or the shore.

From the above description, I think we may consider this animal rather as attempting to save itself from the attacks of its destroyers, than as rowing in pursuit of food. Certain it is, that no creature of the deep has more numerous or more powerful enemies. Its shell is scarcely ever found in perfect preservation; but is generally seen to bear some marks of hostile invasion. Its little arts, therefore, upon the surface of the water may have been given it for protection; and it may be thus endued with comparative swiftness, to avoid the crab, the sea-scorpion, the trochus, and all the slower predacious reptiles that lurk for it at the bottom of the water.

From this general view of snails, they appear to be a much more active animated tribe, than from their figure one would at first conceive. They seem to an inattentive spectator, as mere inert masses of soft flesh, rather loaded than covered with a shell, scarcely capable of motion, and insensible to all the objects around them. When viewed more closely, they are found to be furnished with the organs of life and sensation in tolerable perfection; they are defended with armour that is at once both light and strong; they are as active as their necessities require; and are possessed of appetites more poignant than those of animals that seem much more perfectly formed. In short, they are a fruitful industrious tribe; furnished, like all other animals, with the powers of escape and invasion; they have their pursuits and their enmities; and, of all creatures of the deep, they have most to fear from each other.

CHAP. VI.

OF BIVALVED SHELL-FISH, OR SHELLS OF THE OYSTER KIND.

It may seem whimsical to make a distinction between the animal perfections of turbinated and bivalved shell-fish; or to grant a degree of superiority to the snail above the oyster. Yet this distinction strongly and apparently obtains in nature; and we shall find

[1] *The Oyster, the Mussel, and the Cockle.*—The Mollusca which inhabit bivalved shells, such as the Oyster, the Mussel, and the Cockle, are all *acephalous*; that is, destitute of a head. The two valves of the shell are united at the back by a hinge-joint, often very artificially constructed, having teeth that lock into each other; and the mechanism of this articulation varies much in different species. The hinge is secured by a substance of great strength.

During the life of the animal, the usual and natural state of its shell is that of being kept open for a little distance, so as to allow of the ingress and egress of the water necessary for its nourishment and respiration; but, as a security against danger, it was necessary to furnish the animal with the means of rapidly closing the shell, and retaining the valves in a closed state. These actions being only occasional, yet requiring considerable force, are effected by a muscular power, for which purpose sometimes one, sometimes two, or even a greater number of strong muscles are placed between the valves, their fibres passing directly across from the inner surface of the one to that of the other, and firmly attached to both. They are named, from their office of bringing the valves towards each other, the *adductor muscles*.

The simple actions of opening and closing the valves, are capable of being converted into a means of retreating from danger, or of removing to a more commodious situation, in the case of those bivalves which are not actually attached to rocks or other fixed bodies. Diquemare long ago observed, that even the oyster has some power of locomotion, by suddenly closing its shell, and thereby expelling the contained water with a degree of force, which, by the reaction of the fluid in the opposite direction, gives a sensible impulse to the heavy mass. He notices the singular fact, that oysters which are attached to rocks occasionally left dry by the retreat of the tide, always retain within their shells a quantity of water sufficient for respiration, and that they keep the valves closed till the return of the tide; whereas, those oysters which are taken from greater depths, where the water never leaves them, and are afterwards removed to situations where they are exposed to these vicissitudes, of which they have had no previous experience, improvidently open their shells after the sea has left them; and, by allowing the water to escape, soon perish.

Many bivalved mollusca are provided with an instrument shaped like a leg and foot, which they employ extensively for progressive motion. In the *cardium*, or cockle, this organ is composed of a mass of muscular fibres, interwoven together in a very complex manner, and which may be compared to the muscular structure of the human tongue; the effect in both is the same, namely, the conferring a power of motion in all possible ways; thus it may be readily protruded, retracted, or inflected at every point. The *solen*, or razor-shell fish, has a foot of a cylindrical shape, tapering at the end, and much more resembling in its form a tongue than a foot. In some bivalves the dilatation of the foot is effected by a curious hydraulic mechanism: the interior of the organ is formed of a spongy texture, capable of receiving a considerable quantity of water, which the animal has the power of injecting into it, and of thus increasing its dimensions.

The foot of the *Mytilus edulis*, or common mussel, can be advanced to the distance of two inches from the shell, and applied to any fixed body within that range. By attaching the point to such body, and retracting the foot, this animal drags its shell towards it, and by repeating the operation successively on other points of the fixed object, continues slowly to advance.

the bivalved tribe of animals in every respect inferior to those we have been describing. Inferior in all their sensations; inferior in their powers of motion; but particularly inferior in their system of animal generation. The snail tribe, as we saw, are hermaphrodite, but require the assistance of each other for fecundation; all the bivalve tribe are hermaphrodite in like manner, but they require no assistance from each other towards impregnation; and a single mussel or oyster, if there were on other in the world, would quickly replenish the ocean. As the land-snail, from its being best known, took the lead in the former class, so the fresh-water mussel, for the same reason, may take the lead in this. The life and manners of such as belong to the sea will be best displayed in the comparison.

The mussel, as is well known, whether belonging to fresh or salt water, consists of two equal shells, joined at the back by a strong muscular ligament, that answers all the purposes of a hinge. By the elastic contraction of these, the animal can open its shell at pleasure, about a quarter of an inch from each other. The fish is fixed to either shell by four tendons, by means of which it shuts them close, and keeps its body firm from being crushed by any shock against the walls of its own habitation. It is furnished, like all other animals of this kind, with vital organs, though these are situated in a very extraordinary manner. It has a mouth furnished with two fleshy lips; its intestine begins at the bottom of the mouth, passes through the brain, and makes a number of circumvolutions through the liver; on leaving this organ, it goes on straight into the heart, which it penetrates, and ends in the anus: near which the lungs are placed, and through which it breathes,

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This instrument is of great use to such shell-fish as conceal themselves in the mud or sand, which its structure is then peculiarly adapted for scooping out. The cockle continually employs its foot for this purpose; first elongating it, directing its point downwards, and insinuating it deep into the sand, and next, turning up the end, and forming it into a hook, by which, from the resistance of the sand, it is fixed in its position, and then the muscles which usually retract it are thrown into action, and the whole shell is alternately raised and depressed, moving on the foot as on a fulcrum. The effect of these exertions is to drag the shell downwards. When the animal is moderately active, these movements are repeated two or three times in a minute. The apparent progress is at first but small; the shell, which was raised on its edge at the middle of the stroke, falling back on its side at the end of it; but when the shell is buried so far as to be supported on its edge, it advances more rapidly, sinking visibly at every stroke, till nothing but the extremity of the tube can be perceived above the sand.

By a process exactly the inverse of this, that is, by doubling up the foot, and pushing with it downwards against the sand below, the shell may be again made to rise by the same kind of efforts which before protruded the foot. By this process of burrowing, the animal is enabled quickly to retreat when danger presses, and when this is past, it can, with equal facility, emerge from its hiding-place.

The *Cardium* can also advance at the bottom of the sea along the surface of the soft earth, pressing backwards with its foot, as a boatman impels his boat onwards by pushing with his pole against the ground in a contrary direction. It is, likewise, by a similar expedient, that the *Solen* forces its way through the sand, expanding the end of its foot into the form of a club. The *Tellina* is remarkable for the quickness and agility with which it can spring to considerable distances, by first folding the foot into a small compass, and then suddenly extending it, while the shell is at the same time closed with a loud snap.

The *Pinna*, or marine mussel, when inhabiting the shores of tempestuous seas, is furnished, in addition, with a singular apparatus for withstanding the fury of the surge, and securing itself from dangerous collisions, which might easily destroy the brittle texture of its shell. The object of this apparatus is to prepare a great number of threads, which are fastened at various points to the adjacent rocks, and then tightly drawn by the animal, just as a ship is moored in a convenient station, to avoid the buffeting of the storm. The foot of this bivalve is cylindrical, and has, connected with its base, a round tendon, of nearly the same length as itself, the office of which is to retain all the threads in firm adhesion with it, and concentrate their power, on one point. The threads themselves are composed of a glutinous matter, prepared by a particular organ. They are not spun by being drawn out of the body like the threads of the silk-worm, or of the spider, but they are cast in a mould, where they harden, and acquire a certain consistence before they are employed. This mould is curiously constructed; there is a deep groove which passes along the foot, from the root of the tendon to its other extremity, and the sides of this groove are formed so as to fold and close over it, thereby converting it into a canal. The glutinous secretion, which is poured into this canal, dries into a solid thread; and, when it has acquired sufficient tenacity the foot is protruded, and the thread it contains is applied to the object to which it is to be fixed, its extremity being carefully attached to the solid surface of that object. The canal of the foot is then opened along its whole length, and the thread, which adheres by its other extremity to the large tendon at the base of the foot, is disengaged from the canal. Lastly, the foot is retracted, and the same operation is repeated.

Thread after thread is thus formed, and applied in different directions around the shell. Sometimes the attempt fails, in consequence of some imperfection in the thread; but the animal, as if aware of the importance of ascertaining the strength of each thread, on which its safety depends, tries every one of them as soon as it has been fixed, by swinging itself round, so as to put it fully on the stretch; an action which probably also assists in elongating the thread. When once the threads have been fixed, the animal does not appear to have the power of cutting or breaking them off. The liquid matter out of which they are formed, is so exceedingly glutinous as to attach itself firmly to the smoothest bodies. It is but slowly produced, for it appears that no Pinna is capable of forming more than four, or at most five threads, in the course of a day and night. The threads which are formed in haste, when the animal is disturbed in its operations, are more slender than those which are constructed at its leisure. In Sicily, and other parts of the Mediterranean, these threads have been manufactured into gloves, and other articles, which resemble silk.—*Abridged from Dr Roget's Bridgewater Treatise.*

like those of the snail kind; and in this manner its languid circulation is carried on.[1]

But the organs of generation are what most deserve to excite our curiosity. These consist in each mussel of two ovaries, which are the female part of its furniture, and of two seminal vessels, resembling what are found in the male. Each ovary and each seminal vessel, has its own proper canal: by the ovary canal the eggs descend to the anus; and there also the seminal canals send their fluids to impregnate them. By this contrivance, one single animal suffices for the double purposes of generation; and the eggs are excluded and impregnated by itself alone.

As the mussel is thus furnished with a kind of self-creating power, there are few places where it breeds that it is not found in great abundance. The ovaries usually empty themselves of their eggs in spring, and they are replenished in autumn. For this reason they are found empty in summer, and full in winter. They produce in great numbers, as all bivalved shell-fish are found to do. The fecundity of the snail kind is trifling in comparison to the fertility of these. Indeed it may be asserted as a general rule in nature, that the more helpless and contemptible the animal, the more prolific it is always found. Thus all creatures that are incapable of resisting their destroyers, have nothing but their quick multiplication for the continuation of their existence.

The multitude of these animals in some places is very great; but from their defenceless state, the number of their destroyers are in equal proportion. The crab, the cray-fish, and many other animals, are seen to devour them; but the trochus is their most formidable enemy. When their shells are found deserted, if we then observe closely, it is most probable we shall find that the trochus has been at work in piercing them. There is scarcely one of them without a hole in it; and this probably was the avenue by which the enemy entered to destroy the inhabitant.

But notwithstanding the numbers of this creature's animated enemies, it seems still more fearful of the agitations of the element in which it resides; for if dashed against rocks, or thrown far on the beach, it is destroyed without a power of redress. In order to guard against these, which are to this animal the commonest and the most fatal accidents, although it has a power of slow motion, which I shall presently describe, yet it endeavours to become stationary, and to attach itself to any fixed object it happens to be near. For this purpose, it is furnished with a very singular capacity of binding itself by a number of threads to whatever object it approaches; and these Reaumur supposed are spun artificially, as spiders their webs which they fasten against a wall. Of this, however, later philosophers have found very great reason to doubt. It is therefore supposed that these threads, which are usually called the beard of the mussel, are the natural growth of the animal's body, and by no means produced at pleasure. Indeed the extreme length of this beard in some, which far exceeds the length of the body, seems impossible to be manufactured by the thrusting out and drawing in of the tongue, with the glutinous matter of which the French philosopher supposed those threads were formed. It is even found to increase with the growth of the animal; and as the mussel becomes larger and older, the beard becomes longer, and its filaments more strong.[2] Be this as it will, nothing is more certain than that the mussel is found attached by these threads to every fixed object; sometimes, indeed, for want of such an object, these animals are found united to each other; and though thrown into a lake separately, they are taken out in bunches of many together.

To have some fixed resting place where the mussel can continue, and take its accidental food, seems the state that this animal chiefly desires. Its instruments of motion, by which it contrives to reach the object it wants to bind itself to, is that muscular substance resembling a tongue, which is found long in proportion to the size of the mussel. In some it is two inches long, in others not a third part of these dimensions. This the animal has a power of thrusting out of its shell; and with this it is capable of making a slight furrow in the sand at the bottom. By means of this furrow it can erect itself upon the edge of its shell; and thus continuing to make the furrow in proportion as it goes forward, it reaches out its tongue, that answers the purpose of an arm, and thus carries its shell edge-ways, as in a groove, until it reaches the point intended. There, where it determines to take up its residence, it fixes the ends of its beard, which are glutinous, to the rock or the object, whatever it be; and thus, like a ship at anchor, braves all the agitations of the water. Sometimes the animal is attached by a large number of threads; sometimes but by three or four, that seem scarce able to retain it. When the mussel is fixed in this manner, it lives upon the little earthy particles that the water transports to its shells, and perhaps the flesh of the most diminutive animals. However, it does not fail to grow considerably; and some of this kind have been found a foot long. I have seen the beards a foot and a half; and of

[1] M. Mery. Anat. des Moules d'Etang.

[2] Mercier du Paty, sur le Bouchots a Moules. Tom. ii. de l'Academie de la Rochelle.

this substance the natives of Palermo sometimes make gloves and stockings.

These shell-fish are found in lakes, rivers, and in the sea. Those of the lake often grow to a very large size; but they seem a solitary animal, and are found generally separated from each other. Those of rivers are not so large, but yet in greater abundance; but the sea-mussel of all others is perhaps the most plenty. These are often bred artificially in salt-water marshes that are overflowed by the tide; the fishermen throwing them in at the proper seasons; and there being undisturbed by the agitations of the sea, and not preyed upon by their powerful enemies at the bottom, they cast their eggs, which soon become perfect animals, and these are generally found in clusters of several dozen together. It requires a year for the peopling of a mussel bed; so that, if the number consists of forty thousand, a tenth part may annually be left for the peopling the bed anew. Mussels are taken from their beds from the month of July to October; and they are sold at a very moderate price.[1]

From this animal the oyster differs very little, except in the thickness of its shell, and its greater imbecility. The oyster, like the mussel, is formed with organs of life and respiration, with intestines which are very voluminous, a liver, lungs, and heart. Like the mussel, it is self-impregnated; and the shell, which the animal soon acquires, serves it for its future habitation. Like the mussel, it opens its shell to receive the influx of water; and like that animal is strongly attached to its shell both above and below.

But it differs in many particulars. In the first place, its shells are not equal, the one being cupped, the other flat: upon the cupped shell it is always seen to rest; for if it lay upon the flat side it would then lose all its water. It differs also in the thickness of its shells, which are so strongly lined and defended, that no animal will attempt to pierce them. But though the oyster be secured from the attacks of the small reptiles at the bottom, yet it often serves as an object to which they are attached. Pipe-worms, and other little animals, fix their habitation to the oyster's sides, and in this manner continue to live in security. Among the number of these is a little red worm, that is often found upon the shell; which some, from never seeing oysters copulate, erroneously supposed to be the male by which their spawn was impregnated.

The oyster differs also from the mussel, in being utterly unable to change its situation. The mussel, as we have observed, is capable of erecting itself on an edge, and going forward with a slow laborious motion. The oyster is wholly passive, and endeavours by all its powers to rest fixed to one spot at the bottom. It is entirely without that tongue which we saw answering the purposes of an arm in the other animal; but nevertheless is often attached very firmly to any object it happens to approach. Rocks, stones, pieces of timber, or sea-weeds, all seem proper to give it a fixture, and to secure it against the agitation of the waves. Nothing is so common in the rivers of the tropical climates as to see oysters growing even amidst the branches of the forest. Many trees which grow along the banks of the stream often bend their branches into the water, and particularly the mangrove, which chiefly delights in a moist situation. To these the oysters hang in clusters, like apples upon the most fertile tree; and in proportion as the weight of the fish sinks the plant into the water, where it still continues growing, the number of oysters increase, and hang upon the branches. Thus there is nothing that these shell-fish will not stick to; they are often even found to stick to each other. This is effected by means of a glue proper to themselves, which, when it cements, the joining is as hard as the shell, and is as difficultly broken. The joining substance, however, is not always of glue; but the animal grows to the rocks, somewhat like the mussel, by threads; although these are only seen to take root in the shell, and not, as in the mussel, to spring from the body of the fish itself.

Oysters usually cast their spawn in May, which at first appear like drops of candle-grease, and stick to any hard substance they fall upon. These are covered with a shell in two or three days; and in three years the animal is large enough to be brought to market. As they invariably remain in the places where they are laid, and as they grow without any other seeming food than the afflux of sea-water, it is the custom at Colchester, and other parts of the kingdom, where the tide settles in marshes on land, to pick up great quantities of

[1] Some shell-fish are poisonous when eaten. This is frequently the case with mussels. In the month of June, 1827, a great number of the poor in Leith were poisoned by eating these shell-fish, which they procured from the docks. "The town," says Dr Combe, "was in a ferment, and the magistrates, with great propriety, issued a warning against the use of the mussels. Many deaths were reported, and hundreds of individuals were stated to be suffering under it. Luckily, matters were not so deplorable; but we ascertained that in addition to the man mentioned before, the companion of our patient, an elderly woman, had died. In all, about thirty cases occurred, with great uniformity of symptoms, but varying very much in severity: but none, so far as I know, have left any permanent bad effects." To what cause these deleterious effects are to be ascribed is uncertain. Some attribute them to disease in the fish, or to its being in a state of putrefaction; others to its having fed on some poisonous articles, more particularly on the ores of copper.

small oysters along the shore, which, when first gathered, seldom exceed the size of a sixpence. These are deposited in beds where the tide comes in, and in two or three years grow to a tolerable size. They are said to be better tasted from being thus sheltered from the agitations of the deep; and a mixture of fresh water entering into these repositories, is said to improve their flavour, and to increase their growth and fatness.[1]

The oysters, however, which are prepared in this manner, are by no means so large as those found sticking to rocks at the bottom of the sea, usually called *rock oysters*. These are sometimes found as broad as a plate, and are admired by some as excellent food. But what is the size of these compared to the oysters of the East-Indies, some of whose shells I have seen two feet over! The oysters found along the coast of Coromandel are capable of furnishing a plentiful meal to eight or ten men; but it seems universally agreed, that they are no way comparable to ours for delicacy of flavour.[2]

Thus the mussel and the oyster appear to have but few distinctions, except in their shape and the power of motion in the former. Other bivalved shell-fish, such as the cockle, the scallop, and the razor shell, have differences equally minute. The power of changing place, which some of them effect in a manner quite peculiar to themselves, makes their greatest difference. The scallop is particularly remarkable for its method of moving forward upon land, or swimming upon the surface of the water. When this animal finds itself deserted by the tide, it makes very remarkable efforts to regain the water, moving towards the sea in a most singular manner. It first gapes with its shell as widely as it can, the edges being often an inch asunder; then it shuts them with a jerk, and by this the whole animal rises five or six inches from the ground. It thus tumbles any how forward, and then renews the operation until it has attained its journey's end. When in the water, it is capable of supporting itself upon the surface; and there opening and shutting its shells, it tumbles over and over, and makes its way with some celerity.

The Pivot, or Razor-shell, has a very different kind of motion. As the former moves laboriously and slowly forward, so the razor-shell has only a power of sinking point down-

[1] *Oysters.*—Oysters are said to be in season in every month of the year that has an R in its name, beginning with September and ending with April; but the season in many places extends from August to May. Every city has its favourite oyster-bank. In London, the Colchester and Milton oysters are held in most esteem; Edinburgh has her "whiskered Pandores," and, latterly, Aberdour oysters; and Dublin, the Carlingford and "Powldoodies of Burran." For the convenience of obtaining a ready supply of oysters, they are often transported from their original beds, and laid down on proper places of the coast; but these exiles are seldom found in such perfection as those which are called *natives*—that is, such as have never been rudely torn from their native homes, and sent on voyages of profit. Oysters, when just dredged, may be so packed in small barrels as to keep good for a week or ten days; and in this state they are sent to distant places. They may also be preserved good for some time by *feeding;* and custom, which brings *gourmands* to admire game most when in a state of putridity, has taught them to relish the flavour of stale oysters better than those recently taken from the beds. The fresher oysters are, they are the better, but when to be kept, lay them, bottom downwards, in a tub, or any vessel suited to the quantity to be preserved, and cover them with water in which a good deal of salt is dissolved;—change the water every twelve hours. Most cooks direct that this delicate animal should be fed with oatmeal or flour sprinkled in the water; and others, on the principle which leads a mother of the parish of St Giles to bathe her new-born darling in a drop of gin, are for feeding them with white wine and bread crumbs! It is said, by those who have the charge of fish-ponds, that "fish will eat nothing but what comes out of the sea;" now, though we are not perfectly convinced of this fact, we can at least believe that salt-water gruel is not over well suited to the delicate stomach of an oyster. Those large, fat oysters, called Pandores, which are so much prized in Edinburgh, are said to owe their superior excellence to the blackish contents of the pans of the adjacent salt-works of Prestonpans flowing out upon the beds, a subject worthy the serious investigation of the oyster amateur, who may here receive some excellent hints for fattening and improving the quality of his favourite morsel.

Shell-fish, and the oyster above all, have long been deemed highly restorative and easy of digestion: they are therefore recommended for the food of the delicate and declining, and of those whose digestive powers have been impaired by excess. When eaten for health, an oyster is best swallowed with its own liquor, the moment the shell is opened: or if found too cold for the stomach, a sprinkling of black pepper may be allowed. Vinegar counteracts the effect of eating oysters to enrich the blood, or render it more balsamic; and ought, therefore, to be avoided by the declining. As there are no reasonable bounds to oyster-eating, it may be useful to notice here that, when too many of these or other shell-fish are swallowed, the unpleasant feeling may be removed by drinking half a pint of hot milk. Consumptive persons are recommended to use hot milk after their oysters at all times.

Of the *univalved* shells, the *periwinkle* (Turbo littoreus) and common *whelk* (Buccinum lapillus, *Lin.*) frequently furnish to the poorer classes of our sea-coast towns and villages a repast, perhaps sufficiently wholesome, and certainly not destitute of relish. But, even to them these may be regarded merely in the light of luxuries: it is far otherwise with the still poorer inhabitants of several of the Western isles of Scotland. Periwinkles and limpets (Patella vulgata), which so profusely stud the rocks of their shores, are their daily fare, and on which they are sometimes reduced to the necessity of altogether subsisting. In the Isle of Sky, for example, we are told that there is almost annually a degree of famine, when the poor are left to Providence's care, and prowl, like other animals, along the shores, to pick up limpets and other shell-fish: "the casual repast," adds Mr Pennant, "of hundreds, during part of the year, in these unhappy islands."

[2] The shell here alluded to is probably the *Giant Chama*, a native of the Indian ocean, and the largest shell at present known.

ward. The shells of this animal resemble nothing so much as the haft of a razor; and by this form it is better enabled to dive into the soft sand at the bottom. All the motions of this little animal are confined to sinking or rising a foot downwards or upwards in the sand, for it never leaves the spot where it first was planted. From time to time it is seen to rise about half way out of its hole; but if any way disturbed, it sinks perpendicularly down again. Just over the place where the razor buries itself, there is a small hole like a chimney, through which the animal breathes, or imbibes the sea-water. Upon the desertion of the tide, these holes are easily distinguished by the fishermen who seek for it; and their method of enticing the razor up from the depth of its retreat, is by sprinkling a little sea-salt upon the hole. This melting no sooner reaches the razor below, than it rises instantly strait upwards, and shows about half its length above the surface. This appearance, however, is instantaneous; and if the fisher does not seize the opportunity, the razor buries itself with great ease to its former depth. There it continues secure: no salt can allure it a second time; but it remains unmolested, unless the fisher will be at the trouble of digging it out sometimes two feet below the surface.

Such are the minute differences between bivalved shell-fish; but in the great outlines of their nature they exactly resemble each other. It is particularly in this class of shell-fish that pearls are found in greatest abundance; and it is in the internal parts of those shells that are of a shining silvery colour, that these gems are usually generated; but the pearl is also found to breed as well in the mussel or the scallop as in the oyster. In fact, it is found in all bivalved shells, the insides of which resemble that well-known substance called mother-of-pearl.

Whether pearls be a disease or an accident in the animal is scarcely worth inquiry. The common opinion is, that they are a kind of calculose concretion in the body of the animal, somewhat resembling a stone in the bladder, and are consequently to be considered as a disorder. It is said, in confirmation of this opinion, that those coasts upon which pearls are fished, are very unhealthy; and therefore most probably oysters share the general influence of the climate; it is also added, that those oysters in which pearls are found are always ill-tasted, which is a sign of their being unsound: and, lastly, it is asserted, that the pearl grows sometimes so big as to keep the shells of the animal from shutting, and that thus it dies by being exposed. It is easy to see the weakness of these assertions, which seem neither true nor amusing. To answer them in their own way: If a stone in the bladder be a disorder, a stone in the stomach of an ostrich is a benefit, and so it may be in the shell of an oyster. If the shores where the pearls are fished be unwholesome to man, that, instead of being disadvantageous, is so much the more lucky for the oyster. If the pearl oysters are the worst tasted, so are kites and ravens among birds; and yet we know that they are healthy and long-lived animals. If the oyster had never its shell kept asunder by the pearl within it, that would be a disease indeed; but this, in reality, never happens, for the oyster that breeds a large pearl always breeds a large shell, and the shell itself indents to receive its impression. The pearl upon the whole seems bred from no disorder in the animal, but accidentally produced by the same matter that goes to form the shell. This substance, which is soft at first, quickly hardens; and thus, by successive coats, layer over layer, the pearl acquires its dimensions. If cut through, it will be found to consist of several coats, like an onion; and sometimes a small speck is seen in the middle, upon which the coats were originally formed.

All oysters, and most shell-fish, are found to contain pearls; but that which particularly obtains the name of the pearl oyster, has a large strong whitish shell, wrinkled and rough without, and within smooth and of a silver colour. From these the mother-of-pearl is taken, which is nothing more than the internal coats of the shell, resembling the pearl in colour and consistence. This is taken out, and shaped into that variety of utensils which are found so beautiful: but the pearl itself is chiefly prized; being found but in few oysters, and generally adhering; sometimes making a print in the body of the shell, sometimes at large within the substance of the fish.

There are a great number of pearl fisheries in America and Asia: but as pearls bear a worse price than formerly, those of America are in a great measure discontinued. The most famous of all the Asiatic fisheries is in the Persian Gulf, near the isle of Bahreen.[1] There

[1] *Pearls.*—The Persian Gulf, the shores of Japan, and the Bay of Condatchy in Ceylon, are the situations where pearls are found in greatest abundance at the present day, and where the most extensive fisheries are carried on. The Ceylon coast, in particular, yields in successful seasons a great produce, the revenue derived being sometimes nearly two hundred thousand pounds. In some years, however, the produce falls far short of this, and this deficiency is generally occasioned by the exhaustion, for the time, of the oyster beds. To prevent this, the bays where they are found are marked out into divisions called banks, of which a certain number only are fished each year, the rest being allowed to lie untouched. The fishing season lasts about two months, commencing in February and ending in April; and the particular banks to be wrought upon are put up to auction by government, and farmed out to the highest bidder. Pre-

is another between the coast of Madura and the island of Ceylon; and there was a third on the coast of Japan: but as these noble islanders have a contempt for jewels, and an abhorrence for such Europeans as come in pursuit of them, that fishery, which is thought to be the most valuable of all others, is discontinued. The diving business is now

viously to this, the banks are surveyed, and the beds ascertained to have reached a state of maturity.

The oysters are brought out of the sea, not by means of dredging nets, as in common fisheries, but by men trained to the practice of diving. They proceed in boats to the quarter allotted for the season's operations, each boat containing twenty men, ten of whom are divers, while ten row the boats and assist their companions in reaching the surface of the water after diving. Five of the divers descend at a time, and when they come up, the other five go down; by which alternation the whole have a certain time to recruit between each exertion. The fishing commences at sunrise, and ceases on account of the rising sea-breeze at noon, and during the whole of the intervening period, the divers pursue their hazardous occupation. To facilitate their descent, each of them has a weight attached round his body, or to his feet, in such a way that he can relieve himself of it easily. A bag of network is grasped with his toes, the right hand holds a rope, the left keeps the nostrils closed, and in this condition the diver fearlessly plunges in, and speedily reaches the bottom. Hanging the bag around his neck, he collects as many oysters as he can, generally about a hundred at one time, and on making a signal, is drawn up to the surface; the stone or weight which assisted his descent is hauled out afterwards. The length of time he continues under water is from one to two minutes, although instances have been known of divers who could remain four and even five minutes; and the longest period ever known was that of a diver who could prolong his stay under water full six minutes. The sea at the oyster banks is generally from four to ten fathoms deep, which is a descent easily accomplished by the divers. One boat, with the complement of men we have described, has been known, when the oysters were abundant, to bring to land thirty-three thousand in one day, while at other times a hundred or two are the whole day's produce. The divers on the Asiatic coasts are all natives, trained to this employment from infancy, and so expert from custom that they will make from forty to fifty plunges a-day; but the exertion is so violent, that water, and occasionally blood gushes from the mouth, nose, and ears. Some of the divers use no precautionary means whatever, while others rub their bodies with oil, and stuff their ears and noses to prevent the entrance of the water. They take no food while in the boats, nor till they have bathed themselves with fresh water, after returning to land. The only danger which the divers appear to apprehend in the course of their occupation, is from the shark, particularly the ground shark, which is a native of the Asiatic seas. Some of the divers are so expert in their movements as to avoid this enemy, even when they have been under water for a considerable time; but the chief reliance for security is on the priests and conjurors, some of whom always accompany the boats, by order of government, to inspire courage by their presence. Upon the whole, it must be admitted that few of the divers pursue their occupation voluntarily, but rather act under the compulsion of their employers and masters.

As soon as the boats land with the oysters an immense number of labourers, men, women, and children, rush to them, and carry off the produce of the day's fishing. Every speculator has his own group of huts, and in the midst of each of these is a *couttó*, or space of ground enclosed with poles and transverse pieces of bamboo, but open to the air. In these *couttós* are deposited the oysters as they are landed, and there they are left to putrefy, which they soon do under a burning sun. It is a curious fact, that though these numerous *couttós*, each containing an enormous mass of oysters, all putrefy together on a narrow extent of soil, and emit the most detestable odours, yet the health of the precarious but crowded population gathered there is in no ways affected. "During two consecutive years," says M. de Noé, "that I did duty at the fishery, I never saw a soldier of my regiment sick: Europeans and Sepoys all equally enjoyed good health." And Mr Marshall has observed to us, that in this climate, where the effects of vegetable decomposition are so fatal and so rapid, those of animal decomposition are almost innocuous. As soon as the putrefaction is sufficiently advanced, the oysters are taken from the *couttó*, and placed in troughs, made of the trunk of trees, hollowed; sea-water is then thrown over them. In this putrid state the oysters easily render the pearls they contain; and a number of men, all standing on the same side of the trough, rapidly shake them out and wash them. Inspectors stand at each end of the trough to see that the labourers secrete none of the pearls, and others are in the rear to examine whether the shells thrown out as worthless may not contain some of the precious substance. The workmen are prohibited, under penalty of a beating, to lift their hands to their mouths while they are washing the pearls. Notwithstanding these precautions and the vigilance of the inspectors, a man sometimes contrives to swallow a pearl of high price.

The various operations in preparing pearls for the market, occupy in Ceylon a great number of the inhabitants. After being thoroughly cleansed, they are rounded, and polished with a powder made of the pearls themselves, and arranged into classes according to their various sizes. They are then drilled and strung together, the largest classes being generally sent to the Indian, while the smaller meet with a ready sale in the European, market. The operation of drilling is an exceedingly nice one, and is performed with great expertness by the black people. The drilling instrument is a wooden machine in the form of an inverted cone, in the upper flat surface of which are pits, or depressions, to receive the pearls. The holes are made by spindles of various sizes, which revolve in a wooden head, by the action of a bow handle to which they are attached. During the operation, which is performed with one hand, while the other presses on the machine, the pearls are moistened occasionally, and the whole is done with astonishing rapidity. The colour of the pearls is in general a bluish or silvery white, but they are met with of a variety of hues, transparent, semi-transparent, opaque, brown and black.

The pearl fishery at the Bahreen Islands, in the Persian Gulf, is the most extensive in the world, but very little of its produce is brought to Europe. The pearls are of a golden yellow tint, and are held in great estimation by the Asiatics, on account of their retaining permanently their colour, whereas the white ones are liable to tarnish, and to lose their lustre. The oyster shells from this fishery are of a finer character than usual, and are sent to Constantinople, and to China, where they are manufactured into a great variety of useful and ornamental articles. Long before the discovery of America, pearls were highly valued by the natives; and the Spaniards, on their landing in the country, found large quantities of them in different quarters. The early colonists established regular fisheries, and a great revenue was derived by the Spanish monarchy from their importation into Europe. In one year 697 lbs. of pearls were brought over, many of them of great size and beauty.

carried on only in those countries where the wretchedness of one part of mankind goes to support the magnificence of the other.

The chief fishery, as was said, is carried on in the Persian Gulf, and the most valuable pearls are brought from thence. The value of these jewels increases not only in proportion to their size, but also their figure and colour; for some pearls are white, others are yellowish, others of a lead colour; and some affirm they have been found as black as jet. What it is that gives these different tinctures to pearls is not known: Tavernier ascribes it to their lying two or three weeks upon the shore after the oyster is taken: Reaumur thinks it proceeds from the colour of that part of the fish's body upon which the pearl lies. It is most probable that this colour proceeds, like the spots frequently found on the internal surface of the shell itself, from some accident while the pearl is growing.

The best coloured pearls, and the roundest are brought from the East: those of America are neither so white nor so exactly oval. All pearls, however, in time become yellow; they may be considered as an animal substance converted into a stony hardness, and, like ivory, taking a tincture from the air. They have been even found to decay when in damp or vaulted places, and to moulder into a substance scarcely harder than chalk. When the daughters of Stilicon, who were both betrothed, one after the other, to the emperor Honorius, were buried, much of their finery was also deposited with them in the same tomb. In this manner they remained buried for above eleven hundred years, till the foundations of the church of St Peter were laying. Their tomb was then discovered, and all their finery was found in tolerable preservation except the pearls, which were converted by time and damps into a chalky powder.

The wretched people that are destined to fish for pearls, are either negroes or some of the poorest of the natives of Persia. The inhabitants of this country are divided into tyrants and slaves. The divers are not only subject to the dangers of the deep, to tempests, to suffocation at the bottom, to being devoured by sharks, but from their profession universally labour under a spitting of blood, occasioned by the pressure of air upon their lungs in going down to the bottom. The most robust and healthy young men are chosen for this employment, but they seldom survive it above five or six years. Their fibres become rigid; their eye-balls turn red; and they usually die consumptive.

It is amazing how very long they are seen to continue at the bottom. Some, as we are assured, have been known to continue three quarters of an hour under water without breathing; and to one unused to diving, ten minutes would suffocate the strongest.[1] Whether from some effort the blood bursts the old passage which it had in the fœtus, and circulates without going through the lungs, it is not easy to tell; but certain it is that some bodies have been dissected with this canal of communication open, and these extraordinary divers may be internally formed in that manner.

Be this as it may, no way of life seems so laborious, so dangerous, or so painful. They fish for pearls, or rather the oysters that contain them, in boats twenty-eight feet long; and of these there are sometimes three or four hundred at a time, with each seven or eight stones, which serve for anchors. There are from five to eight divers belonging to each, that dive one after another. They are quite naked, except that they have a net hanging down from the neck to put their oysters in, and gloves on their hands to defend them while they pick the oysters from the holes in the rocks; for in this manner alone can they

From the fishery of St Magueritta, one was sent to Philip II. weighing 250 carats, and valued at 150,000 dollars. From neglect and improper management, the American pearl fisheries now produce little or nothing, and all that is procured is from the gulfs of Panama and California. A fishery of no contemptible extent existed about a century ago in the river Tay, but, either from being exhausted, or from the market being better supplied from other quarters, neither at this point nor on any other part of the British shores does any establishment of the kind now exist.

Pearls are found on analysis to consist of calcareous or chalky matter, disposed in thin coats or layers, an arrangement which corroborates the opinion that they are gradually deposited by the animal upon a small nucleus of sand, or other foreign body, which, being admitted along with the food, causes irritation, to prevent which the animal covers them with a gelatinous fluid, that grows hard by degrees. A grain of sand is often found in the centre of the pearl, but many of the largest want it altogether: and hence we are left in doubt regarding the correctness of the theory. Whatever be the cause of the formation of the pearl, there seems little doubt that it is produced by an unnatural or morbid action; and it is not a little curious, upon the whole, that a little functional derangement in an oyster should generate a gem, which for ages has been an ornament of crowns and courts.

[1] From the previous Note, it will be seen, that the period during which pearl-divers are said to remain under water is here grossly exaggerated. Fifty seconds is about the time that men in the bay of Naples, who dive for *frutta di mare*, or small shell-fish, and the Greek islanders of the Archipelago, who dive for sponges, remain under water; and these two classes are the most famous divers in Europe, and likely, from their physical construction, sober way of living, and constant practice, to carry their art to its utmost natural limits. Ribeyro, a Portuguese officer, who was nineteen years on the island, says, that the Ceylon plunger could stay under water for the space of time in which two *credos* might be repeated, and the Catholic belief may be said over twice in about fifty seconds.

be gathered. Every diver is sunk by means of a stone, weighing fifty pounds, tied to the rope by which he descends. He places his foot in a kind of stirrup, and laying hold of the rope with his left hand, with his right he stops his nose to keep in his breath, as upon going down he takes in a very long inspiration. They are no sooner come to the bottom, but they give the signal to those who are in the boat to draw up the stone; which done, they go to work, filling their net as fast as they can; and then giving another signal, the boats above pull up the net loaded with oysters, and shortly after the diver himself, to take a new inspiration. They dive to the depth of fifteen fathoms, and seldom go deeper. They generally go every morning by break of day to this fatiguing employment, taking the land wind to waft them out to sea, and returning with the sea-breeze at night. The owners of the boats usually hire the divers, and the rest of the boat's crew, as we do our labourers, at so much a day. All the oysters are brought on shore, where they are laid in a great heap, till the pearl fishery is over, which continues during the months of November and December. When opportunity serves, they then examine every oyster, and it is accidental whether the capture turns out advantageous. Indeed no human being can wish well to a commerce, which thus chains such a number of fellow-creatures to the bottom, to pluck up a glittering mouldering pebble.

CHAP. VII.

OF MULTIVALVE SHELL-FISH.

Multivalve Shell-Fish may be considered as animals shut up in round boxes. To view their habitations externally, one would be little apt to consider them as the retreats of living creatures; and still less, to suppose that some of them carry their boxes with a tolerable share of swiftness, so as to escape their pursuers. Of these there are principally two kinds; such as move, and such as are stationary: the first are usually known in our cabinets by the name of Sea-eggs; the others are as often admired, from the cavities which they scoop out for their habitation in the hardest marble. The first are called by naturalists, Echini, or Urchins;[1] the latter are called Pholades, or File fish. Of both there are several sorts; but, by describing these two, we shall have a competent idea of all the rest.

On a slight view, the sea-urchin may be compared to the husk of a chestnut; being, like it, round, and with a number of bony prickles standing out on every side. To exhibit this extraordinary animal in every light—if we could conceive a turnip stuck full of pins on every side, and running upon these pins with some degree of swiftness, we should have some idea of this extraordinary creature The mouth is placed downwards; the vent is above; the shell is a hollow vase, resembling a scooped apple; and this filled with a soft muscular substance, through which the intestines wind from the bottom to the top. The mouth, which is placed undermost, is large and red, furnished with five sharp teeth, which are easily discerned. The jaws are strengthened by five small bones, in the centre of which is a small fleshy tongue; and from this the intestines make a winding of five spires, round the internal sides of the shell, ending at the top, where the excrements are excluded. But what makes the most extraordinary part of this animal's conformation, are its horns and its spines, that point from every part of the body, like the horns of a snail, and that serve at once as legs to move upon, as arms to feel with, and as instruments of capture and defence. Between these horns it has also spines that are not endued with such a share of motion. The spines and the horns issue from every part of its body; the spines being hard and prickly; the horns being soft, longer than the spines, and never seen except in the water. They are put forward and withdrawn like the horns of a snail, and are hid in the bases of the spines, serving, as was said before, for procuring food and motion. All this apparatus, however, is only seen when the animal is hunting its prey at the bottom of the water; for a few minutes after it is taken, all the horns are withdrawn into the body, and most of the spines drop off.

It is generally said of insects, that those which have the greatest number of legs always move the slowest; but this animal seems to be an exception to the rule; for though furnished with two thousand spines, and twelve hundred horns, all serving for legs, and from their number seeming to impede each other's motion, yet it runs with some share of swiftness at the bottom, and it is sometimes no easy matter to overtake it. It is often taken upon the ebb, by following it in shallow water, either in an osier basket, or simply with the hand. Both the spines and the horns assist its motion; and the animal is usually seen running with the mouth downward.

[1] The sea-urchins are very improperly placed in the multivalve division of shells, as they are very different from testaceous worms, not only in their functions, but also in the composition of their shells. They are placed by naturalists in the crustaceous order, the shells or crusts of Echini being composed of phosphate of lime with animal matter; those of the testaceous shells being carbonate of lime.

Some kinds of this animal are as good eating as the lobster; and its eggs, which are of a deep red, are considered as a very great delicacy. But of others the taste is but indifferent; and in all places, except the Mediterranean, they are little sought for, except as objects of curiosity.

Very different in motion, though not much different in shape, from these, are the Acorn Shell-Fish, the Thumb-footed Shell-Fish, and the imaginary Barnacle. These are fixed to one spot, and appear to vegetate from a stalk. Indeed, to an inattentive spectator, each actually seems to be a kind of fungus that grows in the deep, destitute of animal life, as well as motion. But the inquirer will soon change his opinion, when he comes to observe this mushroom-like figure more minutely. He will then see that the animal residing within the shell has not only life, but some degree of voraciousness; that it has a cover, by which it opens and shuts its shell at pleasure; that it has twelve long crooked arms, furnished with hair, which it thrusts forth for its prey; and eight smaller, which are generally kept in the shell. They are seen adhering to every substance that is to be met with in the ocean; rocks, roots of trees, ships' bottoms, whales, lobsters, and even crabs, like bunches of grapes clung to each other It is amusing enough to behold their operations.[1] They for some time remain motionless within their shell; but when the sea is calm, they are seen opening the lid, and peeping about them. They then thrust out their long neck, look round them for some time, and then abruptly retreat back into their box, shut their lid, and lurk in darkness and security. Some people eat them; but they are in no great repute at the tables of the luxurious, where their deformed figure would be no objection to their being introduced.

Of all animals of the shelly tribe, the Pholades are the most wonderful. From their great powers of penetration, compared with their apparent imbecility, they justly excite the astonishment of the curious observer. These animals are found in different places; sometimes clothed in their proper shell, at the bottom of the water; sometimes concealed in lumps of marly earth; and sometimes lodged, shell and all, in the body of the hardest marble. In their proper shell they assume different figures; but, in general, they somewhat resemble a mussel, except that their shell is found actually composed of five or more pieces, the smaller valves serving to close up the openings left by the irregular meeting of the two principal shells. But their penetration into rocks, and their residence there, makes up the most wonderful part of their history.

This animal, when divested of its shell, resembles a roundish soft pudding, with no instrument that seems in the least fitted for boring into stones, or even penetrating the softest substances. It is furnished with two teeth indeed: but these are placed in such a situation as to be incapable of touching the hollow surface of its stony dwelling: it has also two covers to its shell, that open and shut at either end; but these are totally unserviceable to it as a miner. The instrument with which it performs all its operations, and buries itself in the hardest rocks, is only a broad fleshy substance, somewhat resembling a tongue, that is seen issuing from the bottom of its shell. With this soft yielding instrument, it perforates the most solid marbles; and having, while yet little and young, made its way, by a very narrow entrance, into the substance of the stone, it then begins to grow bigger, and thus to enlarge its apartment.

The seeming unfitness, however, of this animal for penetrating into rocks, and there forming a habitation, has induced many philosophers to suppose that they entered the rock while it was yet in a soft state, and from the petrifying quality of the water, that the whole rock hardened round them by degrees. Thus any penetrating quality, it was thought, was unjustly ascribed to them, as they only bored into a soft substance, that was hardened by time. This opinion, however, has been confuted, in a very satisfactory manner, by Dr Bohads, who observed that many of the pillars of the temple of Serapis at Puteoli were penetrated by these animals. From thence he very justly concludes, that the pholades must have pierced into them since they were erected; for no workman would have laboured a pillar into form, if it had been honey-combed by worms in the quarry. In short, there can be no doubt but that the pillars were perfectly sound when erected; and that the pholades have attacked them, during the time in which they continued buried under water, by means of the earthquake that swallowed up the city.[2]

From hence it appears that, in all nature, there is not a greater instance of perseverance and patience than what this animal is seen to exhibit. Furnished with the bluntest and sofest auger, by slow successive applications, it effects what other animals are incapable of performing by force; penetrating the hardest bodies only with its tongue. When, while yet naked, and very small, it has effected an entrance, and has buried its body in the stone, it there continues for life at its ease; the sea-water that enters at the little aperture supplying it with luxurious plenty. When the

[1] Anderson's History of Greenland.

[2] Bohadsch de Animalibus Marinis, p. 153.

animal has taken too great a quantity of water, it is seen to spurt it out of its hole with some violence. Upon this seemingly thin diet it quickly grows larger, and soon finds itself under a necessity of enlarging its habitation and its shell. The motion of the pholas is slow beyond conception; its progress keeps pace with the growth of its body; and, in proportion as it becomes larger, it makes its way farther into the rock. When it has got a certain way in, it then turns from its former direction, and hollows downward; till at last, when its habitation is completed, the whole apartment resembles the bowl of a tobacco pipe; the hole in the shank being that by which the animal entered.

Thus immured, the pholas lives in darkness, indolence, and plenty; it never removes from the narrow mansion into which it has penetrated; and seems perfectly content with being inclosed in its own sepulchre. The influx of the sea-warer that enters by its little gallery satisfies all its wants; and, without any other food, it is found to grow from seven to eight inches long, and thick in proportion.

But they are not supplied only with their rocky habitation; they have also a shell to protect them: this shell grows upon them in the body of the rock, and seems a very unnecessary addition to their defence, which they have procured themselves by art. These shells take different forms, and are often composed of a different number of valves; sometimes six, sometimes but three; sometimes the shell resembles a tube with holes at either end, one for the mouth, and the other for voiding the excrements.

Yet the pholas thus shut up, is not so solitary an animal as it would at first appear; for though it is immured in its hole without egress, though it is impossible for the animal, grown to a great size, to get out by the way it made in, yet many of this kind often meet in the heart of the rock, and like miners in a siege, who sometimes cross each other's galleries, they frequently break in upon each other's retreats. Whether their thus meeting be the work of accident or of choice, few can take upon them to determine: certain it is, they are most commonly found in numbers in the same rock; and sometimes above twenty are discovered within a few inches of each other.[1]

As to the rest, this animal is found in greatest numbers at Ancona, in Italy; it is found along the shores of Normandy and Poitou, in France; it is found also upon some of the coasts of Scotland: and, in general, is considered as a very great delicacy at the tables of the luxurious.

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[1] *Molluscæ*.—Many may have probably noticed, in their ramblings along the sea beach, certain gelatinous transparent masses deposited by the receding tide upon the sands. They resemble very large planoconvex lenses, and are devoid of colour, except in a few minute points, which appear like grains of yellow sand, or the eggs of some shells embedded in their substance. This has led many to consider them as the spawn of some marine animal. If one of these jellies be placed in a tub of brine immediately after it reaches the shore, the observer, will be surprised to find it possessed of animation. The superior, or convex part, will expand like the top of an umbrella, and from its under surface several fringed and leaf-like membranes will be developed. The remains of numerous threads, or tendrils, will float out from the margin of the umbrella, following the motions of the animal as it swims around the tub. These threads are often several feet in length before they are broken by the sand; they are probably employed both to entice and secure the prey, and they produce a sharp, stinging sensation, when applied to the skin. It is from the appearance and offensive power of these last organs, that seamen have given the animal the title of the sea nettle, and naturalists the generic name *Medusa*.

The medusa is a familiar example of the class of animated beings which are the subjects of the following remarks. They are all alike gelatinous and transparent, and many of them melt and flow away when exposed in the open air to the direct rays of the sun.

Of all the tribes of molluscæ which are scattered over every part of the ocean, the most splendid and the best known is the *Portuguese man-of-war* (*Physalia*). This is an oblong animated sack of air, elongated at one extremity into a conical neck, and surmounted by a membraneous expansion running nearly the whole length of the body, and rising above into a semicirclar sail, which can be expanded or contracted to a considerable extent, at the pleasure of the animal. From beneath the body are suspended from ten to fifty or more little tubes, from half an inch to an inch in length, open at their lower extremity, and formed like the flower of the blue-bottle. These have been regarded as temporary receptacles for food, like the first stomach of cattle; but as the animal is destitute of any visible mouth or alimentary canal, and as I have frequently seen fish in their cavities apparently half digested, I cannot but consider them as proper stomachs; nor indeed is it a greater paradox in zoology that an animal should possess many independent stomachs; than that the strange carnivorous vegetable, the saracinea, should make use of its leaves apparently for a similar purpose. From the centre of this group of stomachs depends a little cord, never exceeding the fourth of an inch in thickness, and often forty times as long as the body. The size of the Portuguese man-of-war varies from half an inch to six inches in length. When it is in motion, the sail is accommodated to the force of the breeze, and the elongated neck is curved upward, giving to the animal a form strongly resembling the little glass swans which we sometimes see swimming in goblets.

The mode in which the animal secures his prey has been a subject of much speculation, for the fish and crabs that are frequently found within the little tubes are often large enough to tear them in pieces could they retain their natural vigour during the contest. Deceived by the extreme pain which is felt when the cable is brought into contact with the back of the hand, naturalists have concluded, I think too hastily, that this organ secretes a poisonous or acrid fluid, by which it benumbs any unfortunate fish or other animal that ventures within its toils, allured by the hope of making a meal upon what, in its ignorance, it has mistaken for a worm. The secret will be better explained by a more careful examination of the organ itself. The cord is composed of a narrow layer of contractile fibres, scarcely visible when relaxed, on account of its transparency. If the animal be large, this layer of fibres will sometimes extend itself to the length

of four or five yards. A spiral line of blue bead-like bodies, less than the head of a pin, revolves around the cable from end to end, and under the microscope these beads appear covered with minute prickles, so hard and sharp, that they will readily enter the substance of wood, adhering with such pertinacity that the cord can rarely be detached without breaking. It is to these prickles that the man-of-war owes its power of destroying animals much its superior in strength and activity. When any thing becomes impaled upon the cord the contractile fibres are called into action, and rapidly shrink from many feet in length to less than the same number of inches, bringing the prey within reach of the little tubes by one of which it is immediately swallowed.

I might now proceed to describe many analogous animals scarcely inferior in interest, but it is time to notice some individuals of another tribe, residing beneath the surface, and therefore less generally known.

The grandest of these is the *beroe*. In size and form it precisely resembles a purse, the mouth, or orifice, answering to one of the modern metallic clasps. It is perfectly transparent ; and in order to distinguish its filmy outlines, it is necessary to place it in a tumbler of brine held between the observer and the light. In certain directions the whole body appears faintly irridescent, but there are several longitudinal narrow lines which reflect the full rich tints of the rainbow in the most vivid manner, for ever varying and mingling the hues, even while the animal remains at rest. Under the microscope these lines display a succession of innumerable coloured scales or minute fins, which are kept unceasingly in motion, thus producing the play of colours by continually changing the angle of reflection. The movements of the beroe are generally retrograde, and are not aided by the coloured scales, but depend upon the alternate contraction and dilatation of the mouth. The lips are never perfectly closed, and the little fish and shrimps which play around them are continually entering and leaving them at pleasure. The animal is dependent for its food upon such semi-animated substances as it draws within its grasp by moving slowly backwards in the water, and retains them in consequence of their own feebleness and inability to escape the weakest of snares.

Another tribe of the *sea-purses* (*Salpa*), though much smaller than the beroe, are more complex in structure, and possesses a higher interest in consequence of the singular habits of some of the species. They are double sacks, resembling the beroe in general form, but destitute of irridescence. The outer sack, or mantle, rarely exceeds an inch in length, and is commonly about half as wide. The inner sack is much smaller, and the interval between these forms a cavity for the water which they breathe, and for some of the viscera. Their visible organs are a transparent heart, which can only be seen in the strongest light ; a splendid double row of whitish bead-like cavities forming a spiral line near one extremity, and supposed to be either lungs or ovaries ; numerous broad, flat, pearly muscles, barely distinguished by their mistiness, and an alimentary canal as fine as horse-hair, with a slight enlargement at one spot, which has been called a stomach. This enlargement resembles both in size and colour a grain of sand. From the base of the animal arises two longer and four or five shorter conical spines of jelly, curved into hooks at the points, by means of which numerous individuals attach themselves together in double rows like the leaflets of a pinnated leaf. Cords of this kind, composed of forty or fifty animals, were often taken, but they separate and reattach themselves at pleasure.

To the gregarious habits of this little mollusque we owe a very singular and striking phenomena, which I have never seen noticed by naturalists, although we frequently witnessed it near the Cape of Good Hope. The animals are occasionally found associated together in such countless myriads that the sea is literally filled with them, sometimes over three or four square miles of surface, and to the depth of several fathoms. The yellow spots which have been described being the only coloured portions of their body, give to the whole tract the appearance of a shoal or sand-bank at some distance below the surface. The deception is heightened by the greater smoothness of the water at these places, particularly in calm weather ; for so closely are the animals crowded together, that the water is rendered in a manner less fluid ; the smaller billows break around the margin and are lost, while the heavy waves of the Southern ocean are somewhat opposed in their progress, and take on in a slight degree the usual appearance of the ground-swell. There can be but little doubt that many of the numerous shoals laid down in the charts of this region, but which have never been seen by any but the supposed discoverers, have been immense banks of these gregarious molluscæ. In sailing through a tract of this description, in which the progress of the ship was very sensibly retarded, I have dipt up with the ship's bucket a greater bulk of the animals than of the water in which they were suspended. How wonderful are the effects produced by the minute links of creation !"—*Dr Reynall Coates of Philadelphia.*

OF FROGS, LIZARDS, AND SERPENTS.

BOOK I.

OF FROGS AND TOADS.

CHAP. I.

OF FROGS AND TOADS IN GENERAL.

If we emerge from the deep, the first and most obvious class of amphibious animals that occur upon land are frogs and toads. These, wherever they reside, seem equally adapted for living upon land, and in the water, having their hearts formed in such a manner as to dispense with the assistance of the lungs in carrying on the circulation. The frog and the toad, therefore, can live several days under water, without any suffocation; they want but little air, and what is wanting is supplied by bags, like bladders, which are generally extended with wind, and answer all the purposes of a reservoir from whence to breathe.

To describe the form of animals so well known would be superfluous; to mark those differences that distinguish them from each other may be necessary. The frog moves by leaping; the toad crawls along the ground: the frog is, in general, less than the toad; its colour is brighter, and with a more polished surface; the toad is brown, rough and dusty. The frog is light and active, and its belly comparatively small; the toad is slow, swollen, and incapable of escaping. The frog, when taken, contracts itself so as to have a lump on its back; the toad's back is straight and even. Their internal parts are nearly the same, except that the lungs of the toad are more compact than those of the frog; they have fewer air-bladders, and, of consequence, the animal is less fitted for living under water. Such are the differences with respect to figure and conformation; their habitudes and manners exhibit a greater variety, and require a separate description.

CHAP. II.

OF THE FROG, AND ITS VARIETIES.



The external figure of the frog is too well known to need a description. Its power of taking large leaps is remarkably great, compared to the bulk of its body. It is the best swimmer of all four-footed animals; and nature hath finely adapted its parts for those ends, the arms being light and active, the legs and thighs long, and furnished with very strong muscles.

If we examine this animal internally, we shall find that it has a very little brain for its size; a very wide swallow; a stomach seemingly small, but capable of great distension. The heart in the frog, as in all other animals that are truly amphibious, has but one ventricle; so that the blood can circulate without the assistance of the lungs, while it keeps under water. The lungs resemble a number of small bladders joined together, like the cells of a honey-comb: they are connected to the back by muscles, and can be distended or exhausted at the animal's pleasure. The male has two testiculi lying near the kidneys; and the female has two ovaries lying near the same place; but neither male nor female have any of the external instruments of generation; the anus serving for that purpose in both. Such

are the most striking peculiarities in the anatomy of a frog; and in these it agrees with the toad, the lizard, and the serpent. They are all formed internally pretty much in the same manner, with spongy lungs, a simple heart, and are destitute of the external instruments that serve to continue the kind.

Of all those who have given histories of the frog, Mr Ræsal, of Nuremberg, seems the most accurate and entertaining. His plates of this animal are well known; his assiduity and skilfulness in observing its manners are still more deserving our esteem. Instead, therefore, of following any other, I will take him for my guide; and though it be out of my power to amuse the reader with his beautiful designs, yet there will be some merit in transcribing his history.

The common brown frog begins to couple early in the season, and as soon as the ice is thawed from the stagnating waters. In some places the cold protracts their genial appetite till April; but it generally begins about the middle of March. The male is usually of a grayish brown colour; the female is more inclining to yellow speckled with brown. When they couple, the colours of both are nearly alike on the back; but as they change their skins almost every eighth day, the old one falling off in the form of mucus, the male grows yellower, and the female more brown. In the males the arms and legs are much stronger than in the females; and at the time of coupling, they have upon their thumbs a kind of fleshy excrescence, which they fix firmly to the breast of the female. This Linnæus supposed to be the male instrument of generation; but, by closer inspection, it is found only of service in holding the female in a more strict embrace. It may be cut off, and the impregnation continue unimpaired: it is sometimes found in the opposite sex; and some of the males are found entirely without it; however, when it is cut off, the male cannot hold the female so strongly as before.

The sexes couple only once a year: and then continue united sometimes for four days together. At this time they both have their bellies greatly swollen; that of the female being filled with eggs; the male having the skin of the whole body distended with a limpid water, which is ejected in impregnation. As soon as the male has leaped upon the female, he throws his fore legs round her breast, and closes them so firmly, that it is impossible, with the naked hands, to loose them. The male clasps his fingers between each other, in the same manner as people when they are praying; the thumbs press with their thickest sides against the breast of the female; and though she should struggle ever so much, nothing can induce him to let go his hold. The grasp seems involuntary and convulsive; they cannot be easily torn asunder; and they swim, creep, and live united, for some days successively, till the female hath shed her spawn, which, at length, she does almost in an instant. But how the impregnation is performed, without any apparent instruments of generation, has long been an object of inquiry; and still continues in great obscurity. To investigate the difficulty as carefully as possible, our German philosopher continued to examine their mutual congress for three years together, and availed himself of all the lights that the knife, or analogy, could furnish.[1]

After having chosen twelve couple of frogs that were thus joined to each other, and having placed each couple in a glass vessel with water, he scarcely let them out of his sight day or night, and even sat up two nights together to examine their operations. The first day he observed nothing that deserved remark: but

[1] *Different developments of embryo of Frogs.*—During the cohesion of the two sexes, the female commences the deposition of the spawn, which is fecundated during its passage. When first expelled it consists of numerous small opaque globular bodies, enveloped in a small glairy, or glutinous mass. This latter substance soon absorbs a large quantity of water, and, in the course of an hour or two, each becomes not less than a quarter of an inch in diameter. The consequence of this augmentation in the bulk of the transparent mass, surrounding each embryo, is [illegible] all the latter are removed from each other by a wh[illegible]ter of each globe; and they appear like black d[illegible] distributed throughout a large mass of trans[illegible]

The deposit of th[illegible] at the bottom of the water, notwithst[illegible] but the [illegible]ion of some naturalists, and of Ræsel a[illegible] that they are expelled at the surface. The [illegible]e, probably, arose from the mass of eggs being generally found at the surface; but this arises merely from the disengagement of gas in the substance of the glairy envelope, in consequence of partial decomposition.

The changes which now begin to take place in the embryo are most interesting. They have been detailed in a very minute and satisfactory manner by Rusconi and I have taken considerable pains during the last spring to follow out his investigations, and by actual observation to correct or confirm his account. I may here observe, once for all, that with the exception of a few of the details in the earliest periods, I have been able to satisfy myself of his correctness; and in those points, I believe that I only failed to do so, partly by my not having obtained the ova immediately after their expulsion, and partly by the want of time to enter into all the necessary minutiæ of the investigation.

I have also to observe that the development of the young is more or less rapid, according to the temperature of the atmosphere; and that I was enabled to retard or hasten it by regulating this circumstance. I therefore kept my reservoir of eggs in a very cold situation, and occasionally brought a few of them into my drawing-room for the purpose of observation; in which place, being in an elevated temperature, the development became very rapid. As my object, therefore, was to ascertain positive facts, rather than the periods of the changes, which were dependant upon variable circumstances, I kept no register of the temperature or of the periods; and I shall, in both these particulars, give some of the statements of the accurate Rusconi.

the second they began to be agitated more than before; the males made a noise somewhat resembling the grunting of a hog; the females only kept sinking and rising in the water.



The embryo is found, in the first place, to consist of a small globular body, one side, or hemisphere, of which is of a dark brown colour, the other being much paler. In a very short period after the egg is deposited,—four hours, according to Rusconi,—a deep furrow across the dark hemisphere divides it into two equal parts, and this is soon afterwards crossed by another at right angles; a third and a fourth furrow are produced, and so on, until the whole surface of this side of the sphere is, as it were, granulated. This appearance, however, is but transitory, the surface soon becoming almost smooth. In the course of the second day, the sphere begins to elongate, and a groove, which had previously divided the upper part of it into two equal parts, begins to close up. The head becomes prominent, the tail begins to show itself, the little hooks by which it subsequently lays hold of objects and supports itself, begin to appear. At this period the examination becomes more easy, and more interesting. At somewhat more than fifty hours in an elevated temperature, the head is very well marked, the tail somewhat elongated, and even the rudiment of the membrane, or web, which is destined to form its fin, is visible. About this time, also, a small projection takes place on each side of the head, which is the earliest indication of the branchiæ, and the muscles of the spine may just be seen. In figure 2 of the woodcut, I have given an outline of the embryo in this condition. At this time the water is seen to flow in a distinct and rapid current to the branchial orifice over the rudiments of the branchiæ, which are now just visible, the course of which current I have indicated by arrows. These parts gradually become more developed; the body is more elongated, the branchiæ more distinct; the fin extends round the tail and partly over the back; and the head is distinguished from the body by a slight contraction at the neck; and a short period more suffices to bring it to

The male of the first couple ejected the humidity with which his body was swollen, by which the water in the glass was made muddy; and he soon after quitted the female.—Our philosopher continued for twelve hours to

the condition represented in figures 3, 4, of the woodcut, in which the branchiæ are seen to consist of two tubercles on each side, as yet simple and undivided; the holders, which are small simple organs placed near the situation of the future mouth, and which serve to enable the little animal to attach itself by means of a viscid secretion at their extremities, have become longer, the web, or fin, is also enlarged. By this time the first voluntary motion of the embryo is discovered on the application of any means of excitement or disturbance; but it consists only of a slight movement of the head or tail. The nostrils are seen more distinctly, but the mouth is scarcely yet observable, and shortly afterwards the eye, in a rudimentary state, may be just discerned. The next step in the development is a slight division of the branchiæ into lobes, and the appearance of that beautiful and interesting phenomenon, the circulation of the blood through these organs. The embryo, which is still confined to a curved position by the envelopes (fig. 1), is now seen frequently to extend itself by sudden jerks, as if to emancipate itself from its confinement, which it eventually does by tearing the membrane of the egg. The Tadpoles, we see, are now hatched (fig. 5). According to Rusconi, this takes place within four days after the deposit of the eggs, in a temperature varying only from 23° to 27° Centigr. (73°.4 to 80°.6 Fahr.); but certainly in our own climate, in the ordinary temperature of our spring, it does not take place until at least a month. As I before observed, the development may be greatly hastened by a constant elevation of temperature, and I was often surprised at the degree to which this was the case in the course of my own observations; but the comparatively low temperature of our spring, and the cold frosty nights which occur in March and April, may well account for such a discrepancy. If the eggs be deposited at the middle or latter end of March, it is generally, with us, the latter end of April before they are hatched. The situation of the mouth is now distinctly visible, though the opening is but small; and even when it becomes considerably enlarged it has no power of movement, and there are no distinct lips. The branchiæ now speedily enlarge, and each of the two branches on either side is seen to consist of about four leaves (figs. 6. 9); these are sessile upon the body or stem of the branchia; they are somewhat granular on the surface, and slightly irregular in their form; there is also frequently a short additional branch at the base of the posterior one, as is shown in the outline, figure 9. The present state of these organs, which have now arrived at their maximum of development, constitutes one of the most charming objects for microscopic observation which can be conceived, and to view which a very high power is not necessary, nor even desirable. The current of the blood poured in regular pulsations at each contraction of the heart, passes up each stem or main branch of the branchiæ, and a distinct stream is given off to each leaf; it is propelled to the extremity, and then returns down the opposite sides in the most regular manner, and the parts are so transparent that every globule of blood is distinctly and beautifully visible.

This state of things, however, is destined to last but a short time. No sooner have these interesting organs attained their greatest development than they begin to diminish in size; they become obtuse (fig. 7,) and are gradually so reduced as to be withdrawn within the branchial cavity, and concealed by a little operculum of the integument. The eyes are now perfectly formed. The holders have become much diminished in size; the

observe whether the female would cast her spawn; but finding her tardy, he dissected both her and the male: in the latter, the spermatic vessels were quite empty, as might naturally have been supposed; but for the female, her spawn still remained in her body. Upon its being extracted, and put into water, it perished without producing any animal whatever. From hence he justly concluded, that it required that the eggs should be ejected from the body of the female before they could be at all prolific. In another pair the male quitted the female, who did not eject her spawn till sixteen days after; and these, like the former, came to nothing. But it was very different with some of the rest. The females ejected their spawn while the male still remained in his station, and impregnated the masses at different intervals as they fell from her; and these all brought forth animals in the usual course of generation. From these observations it was easy to infer, that the female was impregnated neither by the mouth, as some philosophers imagined, nor by the excrescence at the thumbs, as was the opinion of Linnæus, but by the inspersion of the male seminal fluid upon the eggs, as they proceeded from the body.

A single female produces from six to eleven hundred eggs at a time; and, in general, she throws them all out together by a single effort; though sometimes she is an hour in performing this task. While she is thus bringing forth, it may be observed that the male acts the part of a midwife, and promotes the expulsion of the eggs by working with his thumbs, and compressing the female's body more closely. The eggs which were compressed in the womb, upon being emitted, expand themselves into a round form, and drop to the bottom of the water; while the male swims off, and strikes with his arms as usual, though they had continued so long in a state of violent contraction.

The egg, or little black globe, which produces a tadpole, is surrounded with two different kinds of liquor. That which immediately surrounds the globe is clear and transparent, and is contained in its proper membrane; that which surrounds the whole is muddy and mucous. The transparent liquor serves for the nourishment of the tadpole from time to time; and answers the same purposes that the white of the egg does to birds. The tadpoles, when this membrane is broken, are found to adhere with their mouth to part of it; and when they get free, they immediately sink to the bottom of the water, never being able to get to the top after, while they continue in their tadpole form.

But to return—When the spawn is emitted and impregnated by the male, it drops, as was said, to the bottom, and there the white quickly and sensibly increases. The eggs, which, during the four first hours, suffer no perceptible change, begin then to enlarge and grow lighter; by which means they mount to the surface of the water. At the end of eight hours the white in which they swim grows thicker, the eggs lose their blackness, and, as they increase in size, somewhat of their spherical form. The twenty-first day, the egg is seen to open a little on one side, and the beginning of a tail to peep out, which becomes more and more distinct every day. The thirty-ninth day the little animal begins to have motion; it moves at intervals its tail; and it is perceived that the liquor in which it is circumfused serves it for nourishment. In two days more some of these little creatures fall to the bottom; while others remain swimming in the fluid around them, while their vivacity and motion is seen to increase. Those which fall to the bottom remain there the whole day; but having lengthened themselves a little, for hitherto they are doubled up, they mount, at intervals, to the mucus which they had quitted, and are seen to feed upon it with great vivacity. The next day they acquire their tadpole form.[1] In three days more they are perceived to have two little fringes, that serve as fins beneath the head; and these, in four days after, assume a more perfect form. It is then, also, that they are seen to feed very greedily upon the pond-weed with which they are to be supplied; and, leaving their former food, on this they continue to subsist till they arrive at maturity. When they come to be ninety-two days old, two small feet are seen beginning to bourgeon near the tail: and the head appears to be separate from the body. The next day the legs are considerably enlarged: four days after

mouth has acquired movable lips, and has changed its position from the inferior part of the head to near the extremity, and the little creature which has hitherto derived its sustenance either from its own resources or by absorption, now seeks its food amid softened and decomposing vegetable matter. The caudal web (fig. 8) has, therefore, become considerably developed, and serves for very rapid as well as varied locomotion. The colour of the body, too, has undergone a considerable change, having become of a soft olive green, the abdomen being dotted with golden yellow. The Tadpole now undergoes but little change in its external form for a considerable time, but increases rapidly in bulk, and by and by a little tubercle appears on each side of the vent, which is the rudiment of the posterior extremity.—*Bell's History of British Reptiles.*

[1] The tadpole is furnished with a small tube beneath the lower jaw, which acts as a sucker, and by means of which it can, at pleasure, attach itself to the under surface of aquatic plants: from these plants it can also suspend itself, when very young, by a kind of glutinous thread, in the same manner as spiders drop from the ceiling to the ground.

they refuse all vegetable food; their mouth appears furnished with teeth; and their hinder-legs are completely formed. In two days more the arms are completely produced; and now the frog is every way perfect, except that it still continues to carry the tail. In this odd situation the animal, resembling at once both a frog and a lizard, is seen frequently rising to the surface, not to take food, but to breathe. In this state it continues for about six or eight hours, and then, the tail dropping off by degrees, the animal appears in its most perfect form.

Thus the frog, in less than a day, having changed its figure, is seen to change its appetites also. So extraordinary is this transformation, that the food it fed upon so greedily but a few days before, is now utterly rejected; it would even starve if supplied with no other. As soon as the animal acquires its perfect state, from having fed upon vegetables, it becomes carnivorous, and lives entirely upon worms and insects. But as the water cannot supply these, it is obliged to quit its native element, and seek for food upon land, where it lives by hunting worms, and taking insects by surprise. At first, being feeble and unable to bear the warmth of the sun, it hides among bushes and under stones; but when a shower comes to refresh the earth, then the whole multitude are seen to quit their retreats, in order to enjoy the grateful humidity. Upon many occasions the ground is seen perfectly blackened with their numbers; some hunting for prey, and some seeking secure lurking places. From the myriads that offer on such occasions, some have been induced to think that these animals were generated in the clouds, and thus showered down on the earth. But had they, like Derham, traced them to the next pool, they would have found out a better solution for the difficulty.

The frog lives for the most part out of the water; but when the cold nights begin to set in, it returns to its native element, always choosing stagnant waters, where it can lie without danger concealed at the bottom. In this manner it continues torpid, or with but very little motion, all the winter: like the rest of the dormant race, it requires no food; and the circulation is slowly carried on without any assistance from the air.

It is at the approach of spring that all these animals are roused from a state of slumber to a state of enjoyment. A short time after they rise from the bottom they begin to pair, while those that are as yet too young come upon land before the rest. For this reason, while the old ones continue concealed in the beginning of spring, the small ones are more frequently seen; the former remaining in the lake to propagate, while the latter are not yet arrived at a state of maturity.[1]

The difference of sexes, which was mentioned above, is not perceivable in these ani-

[1] There are various species of frogs, of which we may notice the more remarkable. The Common Frog of this country is called the Red Frog by the French. The *Green Frog* is the common frog of France, and is the one chiefly used at table. Its thighs are in great request there among the amateurs of good cheer, although in this country a stupid prejudice exists against it. Its colour is an olive green, distinctly marked with black patches on the back, and on its limbs with transverse bars of the same. From the tip of the nose three distinct stripes of a pale yellow extend to the extremity of the body, the middle one slightly depressed, and the lateral ones considerably elevated. The under parts are of a pale whitish colour tinged with green, and marked with irregular brown spots. Though not common in England, it is found in great plenty in Italy, France, and Germany. This species seldom deposits its spawn before the month of June. During this season the male is said to croak so loud as to be heard at a great distance. In some particular places, where these animals are numerous, their croaking is very oppressive to persons unaccustomed to it. The globules of spawn are smaller than those of the common frog; and the young are considerably longer in attaining their complete state, this seldom taking place till November. They arrive at their full growth in about four years, and live to the age of sixteen or seventeen. They are excessively voracious, frequently seizing young birds, and even mice, which, like the rest of their prey of snails, worms, &c. they swallow whole.

Edible frogs are brought from the country, thirty or forty thousand at a time, to Vienna, and sold to the great dealers, who have conservatories for them, which are large holes, four or five feet deep, dug in the ground, the mouth covered with a board, and in severe weather with straw. In these conservatories, even during a hard frost, the frogs never become quite torpid; when taken out, and placed on their backs, they are always sensible of the change, and have strength enough to turn themselves. They get together in heaps, one upon another, instinctively, and thereby prevent the evaporation of their humidity; for no water is ever put to them. In Vienna, in the year 1793, there were only three great dealers, by whom most of those persons were supplied who brought them to the market ready for the cook. As their spawning time is so very late in the year, those animals that are brought to market before the month of June for edible frogs, are supposed to be either common frogs, or sometimes toads.

The large water, or *Bull-frog*, is also edible, having as much on them as a young fowl. It frequently measures from the nose to the hind feet, a foot and a half, or upwards. Its colour is a dusky olive brown, marked with numerous dark spots, lighter beneath than above. The external membranes of the ears are large, round, and of a brownish red surrounded by a yellowish margin. This species is chiefly found in the anterior parts of America, where, at the springs and small rills, they are said to sit in pairs. Kalm, however, says, that they frequent only ponds and marshes. In Virginia they are in such abundance, that there is scarcely a single spring that has not a pair of them. The inhabitants, who respect them as genii of the fountains, imagine that they purify the water. The women, however, are no friends to them, because they kill and eat young ducks and goslings; and sometimes they carry off chickens that venture too near the pond. When suddenly surprised, by a long leap or two they enter their hole, at the bottom of which they lie perfectly secure. A full-grown bull-frog will sometimes leap three yards. Kalm relates the following story respecting one

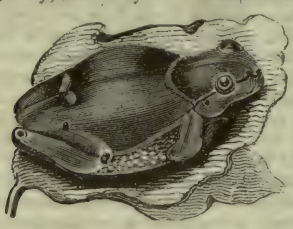
mals, until they have arrived at their fourth year; nor do they begin to propagate, till they have completed that period. By comparing their slow growth with their other habitudes, it would appear that they live about twelve years; but having so many enemies, both by land and water, it is probable that few of them arrive at the end of their term.

Frogs live upon insects of all kinds; but

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of them. The American Indians are known to be excellent runners, being almost able to equal the best horse in its swiftest course. In order, therefore, to try how well the bull-frog could leap, some Swedes laid a wager with a young Indian that he could not overtake one of them, provided it had two leaps beforehand. They carried a bull-frog, which they had caught in a pond, into a field, and burnt its tail. The fire and the Indian who endeavoured to get up to the frog, had together such an effect on the animal, that it made its long leaps across the field as fast as it could. The Indian pursued it with his might. The noise he made in running frightened the poor frog; probably it was afraid of being tortured with fire again, and therefore it redoubled its leaps, and by that means reached the pond, which was fixed on as their goal, before the Indian could overtake it. This animal is called the bull-frog on account of its croaking, which is said somewhat to resemble the hoarse lowing of a bull; and when, in a calm night, many of them are making a noise together, they may be heard to the distance of a mile and a half. The night is the time when they croak, and they are said to do it at intervals. In this act they are either hidden among the grass or rushes, or they are in the water, with their heads above the surface. Kalm informs us that, as he was one day riding out, he heard one of them roaring before him, and supposed it to be a bull hidden in the bushes at a little distance. The voice was, indeed, more hoarse than that of a bull, yet it was too loud for him to conceive that it could be emitted by so small an animal as a frog, and he was in considerable alarm for his safety. He was undeceived a few hours afterwards, by a party of Swedes, to whom he had communicated his fears.

The *Tree-frog*, which is a native of America, France, Germany, Italy, and many other European regions, but



never found in Britain, is small, and of a slender and very elegant shape. It is the only species found in Europe of a genus called *Hylæ*, which are distinguished from frogs and toads by the viscous cushions by which the toes are terminated. Its upper parts are green, and the abdomen is whitish, marked by numerous granules. The under surface of the limbs is reddish, and on each side of the body there is a longitudinal blackish or violet-coloured streak. The body is smooth above, and the hind legs are very long and slender. At the end of each toe is a round, fleshy, concave apparatus, not unlike the mouth of a leech, by means of which the animal is enabled to adhere even to the most polished surfaces. This animal, during the summer months, resides principally on the upper branches of the trees, where it wanders among the foliage in quest of insects. These it catches with great dexterity, stealing softly to them, as a cat does to a mouse, till at a proper distance, when it makes a sudden spring upon them of frequently more than a foot in height. It often suspends itself by its feet, or abdomen, to the upper parts of leaves, remaining thus concealed among the foliage. The skin of the abdomen

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is covered with small glandular granules of such a nature as to allow the animal to adhere as well by these as by the toes. It will even stick to glass by pressing its belly against it. About the end of autumn the tree-frog retires to the water and lies concealed in a torpid state in the mud till the spring, when, on the return of warm weather, it emerges, like the rest of the genus, to deposit its spawn in the water. At this period the male inflates his throat in a surprising manner, forming a large sphere beneath his head; he also exerts a very loud and sharp croak, that may be heard to a vast distance. The tadpoles become perfected about the beginning of August, and they soon afterwards begin to ascend the adjacent trees. At this time they are particularly noisy in the evenings on the approach of rain; therefore, if kept in glasses in a room, and supplied with proper food, they will supply the place of barometers by affording sure presage of changes of weather.

Tree-frogs have been kept also by Dr Townson, who had them in a window, and appropriated to their use a bowl of water, in which they lived. They soon grew quite tame; and to two that he had had for a considerable length of time, and were particular favourites, the doctor gave the names of Damon and Musidora. In the evening they seldom failed to go into the water, unless the weather was cold and damp, in which case they would sometimes stay out a couple of days. When they were out of the water, if a few drops were thrown upon the board, they always applied their bodies as close to it as they could; and from this absorption through the skin, though they were flaccid before, they soon again appeared plump. A tree frog that had not been in the water during the night was weighed, and then immersed; after it had remained half an hour in the bowl it came out, and was found to have absorbed nearly half its own weight in water. From other experiments, it was discovered that these animals frequently absorbed nearly their whole weight of water; and that, as was clearly proved, by the under surface only of the body. They will even absorb water from wetted blotting paper. Sometimes they eject water with considerable force from their bodies, to the quantity of a fourth part or more of their weight. Before the flies had disappeared in autumn, the doctor collected for his favourite tree-frog, Musidora, a great quantity, as winter provision. When he laid any of them before her she took no notice of them, but the moment he moved them with his breath, she sprung upon and ate them. Once, when flies were scarce, the doctor cut some flesh of a tortoise into small pieces, and moved them by the same means; she seized them, but the instant afterwards rejected them from her tongue. After he had obtained her confidence, she ate from his fingers dead as well as living flies. Frogs will leap at the moving of any small object: and, like toads, they will also soon become sufficiently familiar to sit on the hand, and be carried from one side of a room to the other, to catch flies as they settle on the wall. This gentleman accordingly made them his guards at Gottingen, for keeping these troublesome creatures from his dessert of fruit, and they performed their task highly to his satisfaction. He has seen the small tree-frogs eat humble-bees, but this was never done without some contest; they are in general obliged to reject them, being incommoded by their stings and hairy roughness; but in each attempt the bee is further covered with the viscid matter from the frog's tongue, and when thus coated it is swallowed with facility.

A battle between a tree-frog and snake was seen in

they never eat any unless they have motion, They continue fixed and immovable till their prey appears; and just when it comes sufficiently near, they jump forward with great agility, dart out their tongues, and seize it with certainty. The tongue, in this animal, as in the toad, lizard, and serpent kinds, is extremely long, and formed in such a manner, that it swallows the point down its throat; so that a length of tongue is thus drawn out, like a sword from its scabbard, to assail its prey. This tongue is furnished with a glutinous substance; and whatever insect it touches, infallibly adheres, and is thus held fast till it is drawn into the mouth.

As the frog is thus supplied with the power of catching its prey, it is also very vivacious, and able to bear hunger for a very long time. I have known one of them continue a month in summer without any other food than the turf on which it was placed in a glass vessel. We are told of a German surgeon, that kept one eight years in a glass vessel, covered with a net. Its food was at all times but sparing: in summer he gave it fresh grass, which it is said to have fed upon; and, in the winter, hay, a little moistened; he likewise, now and then, put flies into the glass, which it would follow with an open mouth, and was very expert in catching them. In winter, when the flies were difficult to be found, it usually fell away, and grew very lean; but in the summer, when they were plenty, it soon grew fat again. It was kept in a warm room, and was always lively and ready to take its prey: however, in the eighth winter, when there were no flies to be found, it fell away and died. It is not certain how long it might have lived, had it been supplied with proper nourishment; but we are certain, that a very little food is capable of sufficing its necessities.

Nor is the frog less tenacious of life. It will live and jump about several hours after its head has been cut off. It will continue active, though all its bowels are taken out; and it can live some days, though entirely stripped of its skin. This cruel trick, which is chiefly practised among school-boys, of skinning frogs, an operation which is done in an instant, seems for some hours no way to abate their vigour. I am assured that some of them get a new skin, and recover, after this painful experiment.

The croaking of frogs is well known; and, from thence, in some countries, they are distinguished by the ludicrous title of Dutch Nightingales. Indeed, the aquatic frogs of Holland are loud beyond what one would imagine. We could hardly conceive that an animal, not bigger than one's fist, should be able to send forth a note that is heard at three miles' distance; yet such is actually the case.[1] The large water-frogs have a note as loud as the bellowing of a bull; and, for this purpose, puff up the cheeks to a surprising magnitude. Of all frogs, however, the male only croaks; the female is silent, and the voice in the other seems to be the call to courtship. It is certain, that at these times when they couple, the loudness of their croaking is in some places very troublesome; for then the whole lake seems vocal; and a thousand dissonant notes perfectly stun the neighbourhood. At other times, also, before wet weather, their voices are in full exertion: they are then heard with unceasing assiduity, sending forth their call, and welcoming the approaches of their favourite moisture. No weather-glass was ever so true as a frog in foretelling an approaching change; and, in fact, the German surgeon, mentioned above, kept his frog for that purpose. It was always heard to croak at the approach of wet weather; but was as mute as a fish when it threatened a continuance of fair. This may probably serve to explain an opinion which some entertain, that there is a month in the year, called *Paddock Moon*, in which the frogs never croak: the whole seems to be no more than that, in the hot season, when the moisture is dried away, and consequently, when these animals neither enjoy the quantity of

the top of a mangrove-tree, by one of the officers who was with Captain Stedman, when he was sailing up one of the rivers of Surinam in a canoe. When the captain first perceived them, the head and shoulders of the frog were in the jaws of the snake, which was about the size of a large kitchen poker. This creature had its tail twisted round a tough limb of the mangrove, while the frog, which appeared about the size of a man's fist, had laid hold of a twig with his hind feet. In this position they were contending, the one for life, the other for his dinner, forming one straight line between the two branches; and thus they continued for some time, apparently stationary, and without a struggle. Still it was hoped, that the poor frog might extricate himself by his exertions, but the reverse was the case. The jaws of the snake, gradually relaxing, and by their elasticity forming an incredible orifice, the body and fore legs of the frog by little and little disappeared, till finally nothing more was seen than the hinder feet and claws, which were at last disengaged from the twig, and its formidable adversary drew it down its throat by suction. The frog passed some inches further down the alimentary canal, and at last stuck, forming a knob or knot at least six times as thick as the snake, whose jaws and throat immediately contracted, and resumed their former natural shape.

The *Fire Frog*—The fire-frog is the least of all the European frogs, hardly ever equalling the tree-frog in size, and is a native of Germany, Italy, and many other parts of Europe, but is not found in England. Its colour on the upper part is of a dull olive brown, the skin being marked with large and small tubercles: round the edges of the mouth is placed a row of blackish streaks or perpendicular spots. The under parts both of the body and limbs are orange-coloured, spotted or variegated with irregular markings of dull blue. It is from the colour of the under surface of its body that this species has obtained the name of fire-frog.

[1] Rœsel. ibid.

health or food that at other times they are supplied with, they show, by their silence, how much they are displeased with the weather. All very dry weather is hurtful to their health, and prevents them from getting their prey. They subsist chiefly upon worms and snails; and as drought prevents these from appearing, the frog is thus stinted in its provisions, and also wants that grateful humidity which moistens its skin, and renders it alert and active.

As frogs adhere closely to the backs of their own species, so it has been found, by repeated experience, they will also adhere to the backs of fishes. Few that have ponds, but know that these animals will stick to the backs of carp, and fix their fingers in the corner of each eye. In this manner they are often caught together; the carp blinded and wasted away. Whether this proceeds from the desires of the frog, disappointed of its proper mate, or whether it be a natural enmity between frogs and fishes. I will not take upon me to say. A story told us by Walton, might be apt to incline us to the latter opinion.

"As Dubravius, a bishop of Bohemia, was walking with a friend by a large pond in that country, they saw a frog, when a pike lay very sleepily and quiet by the shore side, leap upon his head, and the frog having expressed malice or anger by his swoln cheeks and staring eyes, did stretch out his legs, and embraced the pike's head, and presently reached them to his eyes, tearing with them and his teeth those tender parts; the pike, irritated with anguish, moves up and down the water, and rubs himself against weeds, and whatever he thought might quit him of his enemy; but all in vain, for the frog did continue to ride triumphantly, and to bite and torment the pike till his strength failed, and then the frog sunk with the pike to the bottom of the water: then presently the frog appeared again at the top, and croaked, and seemed to rejoice like a conqueror; after which he presently retired to his secret hole. The bishop, that had beheld the battle, called his fisherman to fetch his nets, and by all means to get the pike, that they might declare what had happened. The pike was drawn forth, and both his eyes eaten out; at which, when they began to wonder, the fisherman wished them to forbear, and assured them he was certain that pikes were often so served."

CHAP. III.

OF THE TOAD, AND ITS VARIETIES.

If we regard the figure of the toad, there seems nothing in it that should disgust more than that of the frog. Its form and proportions are nearly the same; and it chiefly differs in colour, which is blacker; and its slow and heavy motion, which exhibits nothing of the agility of the frog: yet such is the force of habit, begun in early prejudice, that those who consider the one as a harmless playful animal, turn from the other with horror and disgust. The frog is considered as a useful assistant, in ridding our grounds of vermin; the toad, as a secret enemy, that only wants an opportunity to infect us with its venom.



The imagination, in this manner biassed by its terrors, paints out the toad in the most hideous colouring, and clothes it in more than natural deformity. Its body is broad; its back flat; covered with a dusky pimpled hide; the belly is large and swagging; the pace laboured and crawling; its retreat gloomy and filthy; and its whole appearance calculated to excite disgust and horror: yet, upon my first seeing a toad, none of all these deformities in the least affected me with sensations of loathing: born, as I was, in a country where there are no toads, I had prepared my imagination for some dreadful object; but there seemed nothing to me more alarming in the sight, than in that of a common frog; and indeed, for some time, I mistook, and handled the one for the other. When first informed of my mistake, I very well remember my sensations: I wondered how I had escaped with safety, after handling and dissecting a toad, which I had mistaken for a frog. I then began to lay in a fund of horror against th whole tribe, which, though convinced they are harmless, I shall never get rid of. My first imaginations were too strong not only for my reason, but for the conviction of my senses.

As the toad bears a general resemblance of figure to the frog, so also it resembles that animal in its nature and appetites. Like the frog, the toad is amphibious; like that animal it lives upon worms and insects, which it seizes by darting out its length of tongue; and in the same manner also it crawls about in moist weather. The male and female couple as in all the frog kind; their time of propagation being very early in the spring. Sometimes the females are seen upon land oppressed by the males; but more frequently they are

coupled in the water. They continue together some hours, and adhere so fast as to tear the very skin from the parts they stick to. In all this they entirely resemble the frog; but the assistance which the male lends the female, in bringing forth, is a peculiarity in this species that must not be passed over in silence. "In the evening of a summer's day, a French gentleman, being in the king's gardens at Paris, perceived two toads coupled together, and he stopped to examine them. Two facts equally new surprised him; the first was the extreme difficulty the female had in laying her eggs; the second was the assistance lent her by the male for this purpose. The eggs of the female lie in her body, like beads on a string; and after the first, by great effort, was excluded, the male caught it with his hinder paws, and kept working it till he had thus extracted the whole chain. In this manner the animal performed, in some measure, the functions of a midwife; impregnating, at the same time, every egg as it issued from the body.

It is probable, however, that this difficulty in bringing forth obtains only upon land; and that the toad, which produces its spawn in the water, performs it with as much ease as a frog. They propagate in England exactly in the manner of frogs; and the female, instead of retiring to dry holes, goes to the bottom of ponds, and there lies torpid all the winter, preparing to propagate in the beginning of spring. On these occasions, the number of males is found greatly to surpass that of the other sex, there being above thirty to one; and twelve or fourteen are often seen clinging to the same female.

When, like the frog, they have undergone all the variations of their tadpole state, they forsake the water; and are often seen, in a moist summer's evening, crawling up, by myriads, from fenny places, into dryer situations. There, having found out a retreat, or having dug themselves one with their mouth and hands, they lead a patient solitary life, seldom venturing out, except when the moisture of a summer's evening invites them abroad. At that time the grass is filled with snails, and the pathways covered with worms, which make their principal food. Insects also of every kind they are fond of; and we have the authority of Linnæus for it, that they sometimes continue immovable, with the mouth open, at the bottom of shrubs, where the butterflies, in some measure fascinated, are seen to fly down their throats.[1]

In a letter from Mr Arscott, there are some curious particulars relating to this animal, which throw great light upon its history. "Concerning the toad," says he, "that lived so many years with us, and was so great a favourite, the greatest curiosity was its becoming so remarkably tame; it had frequented some steps before our hall-door some years before my acquaintance commenced with it, and had been admired by my father for its size, (being the largest I ever met with,) who constantly paid it a visit every evening. I knew it myself above thirty years; and by constantly feeding it, brought it to be so tame, that it always came to the candle, and looked up, as if expecting to be taken up and brought upon the table, where I always fed it with insects of all sorts. It was fondest of flesh maggots, which I kept in bran; it would follow them, and when within a proper distance, would fix his eyes, and remain motionless for near a quarter of a minute, as if preparing for the stroke, which was an instantaneous throwing its tongue at a great distance upon the insect, which stuck to the tip by a glutinous matter. The motion is quicker than the eye can follow. I cannot say how long my father had been acquainted with the toad, before I knew it; but when I was first acquainted with it, he used to mention it as the old toad I have known so many years; I can answer for thirty-six years. This old toad made its appearance as soon as the warm weather came; and I always concluded it retired to some dry bank, to repose till spring. When we new layed the steps, I had two holes made in the third step, on each, with a hollow of more than a yard long for it; in which I imagine it slept, as it came from thence at its first appearance. It was seldom provoked. Neither that toad, nor the multitudes I have seen tormented with great cruelty, ever showed the least desire of revenge, by spitting or emitting any juice from their pimples. Sometimes, upon taking it up, it would let out a great quantity of clear water, which, as I have often seen it do the same upon the steps when quite quiet, was certainly its urine, and no more than a natural evacuation. Spiders, millipedes, and flesh maggots, seem to be this animal's favourite food. I imagine if a bee was to be put before a toad, it would certainly eat it to its cost;[2] but as bees are seldom stirring at the same time that toads are, they rarely come in their way; as they do not appear after sun-rising, or before sun-set. In the heat of the day they will come to the mouth of their hole, I believe for air. I once, from my parlour window, observed a large toad I had in the bank of a bowling-green, about twelve at noon in a very hot day, very busy and active upon the grass. So uncommon an appearance made me go out

[1] Amænit. vol. vi. p. 201.

[2] Ræsel tried a frog; it swallowed the bee alive: its stomach was stung, and the animal vomited it up again.

to see what it was; when I found an innumerable swarm of winged ants had dropped round his hole; which temptation was as irresistible as a turtle would be to a luxurious alderman. In respect to its end, had it not been for a tame raven, I make no doubt but it would have been now living. This bird, one day seeing it at the mouth of its hole, pulled it out, and, although I rescued it, pulled out one eye, and hurt it so, that notwithstanding its living a twelvemonth, it never enjoyed itself, and had a difficulty of taking its food, missing the mark for want of its eye. Before that accident, it had all the appearance of perfect health."

To this account of the toad's inoffensive qualities, I will add another from Valisnieri, to show that, even taken internally, the toad is no way dangerous. In the year 1692, some German soldiers, who had taken possession of the castle of Arceti, finding that the peasants of the country often amused themselves in catching frogs, and dressing them for the table; resolved to provide themselves with a like entertainment, and made preparations for frog fishing, in the same manner. It may easily be supposed that the Italians and their German guests were not very fond of each other; and indeed it is natural to think that the soldiers gave the poor people of the country many good reasons for discontent. They were not a little pleased, therefore, when they saw them go to a ditch where toads, instead of frogs, were found in abundance. The Germans, no way distinguishing in their sport, caught them in great numbers; while the peasants kept looking on, silently flattering themselves with the hopes of speedy revenge. After being brought home, the toads were dressed up after the Italian fashion: the peasants were quite happy at seeing their tyrants devour them with so good an appetite, and expected every moment to see them drop down dead. But what was their surprise to find that the Germans continued as well as ever, and only complained of a slight excoriation of the lips, which, probably, arose from some other cause than that of their repast."

I will add another story, from Solenander; who tells us, that a tradesman of Rome and his wife who had long lived together with mutual discontent; the man was dropsical, and the woman amorous: this ill-matched society promised soon, by the very infirm state of the man, to have an end; but the woman was unwilling to wait the progress of the disorder; and therefore concluded that, to get rid of her husband, nothing was left her but poison. For this purpose she chose out a dose that she supposed would be the most effectual; and having calcined some toads, mixed their powder with his drink. The man, after taking a hearty dose, found no considerable inconvenience, except that it greatly promoted urine. His wife, who considered this as a beginning symptom of the venom, resolved not to stint the next dose, but gave it in greater quantities than before. This also increased the former symptom; and, in a few days the woman had the mortification to see her detested husband restored to perfect health, and remained in utter despair of ever being a widow.

From all this it will appear with what injustice this animal has hitherto been treated. It has undergone every kind of reproach; and mankind have been taught to consider, as an enemy, a creature that destroys that insect-tribe which are their real invaders. We are to treat, therefore, as fables, those accounts that represent the toad as possessed of poison to kill at a distance; of its ejecting its venom, which burns wherever it touches; of its infecting those vegetables near which it resides; of its excessive fondness for sage, which is rendered poisonous by its approach; these, and a hundred others of the same kind, probably took their rise from an antipathy which some have to all animals of the kind. It is a harmless, defenceless creature, torpid and unvenomous, and seeking the darkest retreats, not from the malignity of its nature, but the multitude of its enemies.

Like all the frog kind, the toad is torpid in winter. It chooses then, for a retreat, either the hollow root of a tree, the cleft of a rock, or sometimes the bottom of a pond, where it is found in a state of seeming insensibility. As it is very long-lived, it is very difficult to be killed; its skin is tough, and cannot be easily pierced; and, though covered with wounds, the animal continues to show signs of life, and every part appears in motion. But what shall we say to its living for centuries lodged in the bosom of a rock, or cased within the body of an oak-tree, without the smallest access on any side either for nourishment or air, and yet taken out alive and perfect! Stories of this kind it would be as rash to contradict as difficult to believe; we have the highest authorities bearing witness to their truth, and yet the whole analogy of nature seems to arraign them of falsehood. Bacon asserts that toads are found in this manner; Dr Plot asserts the same. There is, to this day, a marble chimney-piece, at Chatsworth, with the print of a toad upon it, and a tradition of the manner in which it was found. In the Memoirs of the Academy of Sciences there is an account of a toad found alive and healthy in the heart of a very thick elm, without the smallest entrance or egress.[1] In the year 1731, there was another found, near Nantes,

[1] Vide the year 1719.

in the heart of an old oak, without the smallest issue to its cell; and the discoverer was of opinion, from the size of the tree, that the animal could not have been confined there less than eighty or a hundred years, without sustenance and without air. To all these we can only oppose the strangeness of the facts; the necessity this animal appears under of receiving air; and its dying, like all other animals, in the air-pump, when deprived of this all-sustaining fluid. But whether these be objections to weigh against such respectable and disinterested authority I will not pretend to determine; certain it is that if kept in a damp place, the toad will live for several months without any food whatsoever.[1]

To this extraordinary account, which is doubtful, I will add another not less so; which is, that of toads sucking cancerous breasts, and thus extracting the venom, and performing a cure. The first account we have of

[1] In 1777, Herissaut undertook some experiments to ascertain the truth of facts of this kind, which might appear fabulous. He shut up three toads in sealed boxes in plaster, and they were deposited in the Academy of Sciences. At the end of eighteen months one of these toads was dead, but the other two were still living. Nobody could doubt the authenticity of this fact, yet the experiments were severely criticised, as well as the observations which they seemed to confirm. It was contended that the air must have come to these animals through some imperceptible hole which escaped the notice of the observer. Some probability, however, was given to this circumstance by the researches of Dr Edwards, published in 1817. He observed that toads, shut up totally in plaster, and absolutely deprived of air, lived for a great number of days, and much longer than those which were forced to remain under water. This certainly is one of the most extraordinary phenomena which the history of reptiles can furnish. It appears an exception to the necessity of air, which is regarded as indispensable to the life of all animals, and seems to break the chain which united them under the most interesting relations of existence. It appears, however, that the air evidently penetrated through the plaster, as Dr Edwards proved, for the toads perished as soon as the plaster which enclosed them was placed under water. The opponents of Herissaut were therefore justified to some degree in their scepticism. Still the fact of animals existing so long under such circumstances, even with a little air, is most surprising, and calculated to produce very strange reflections. If these reptiles lived in this manner longer than they would have done in the open dry air, the reason is that they lost less by transpiration, and if they died much later than they would have done in water, it was because the air certainly had some access to them.

Professor Buckland has recently made some experiments in order to throw light on this obscure subject. Two blocks of stone were taken, one of porous oolite limestone, and one of a compact silicious sandstone; twelve cells, five inches wide, and six inches deep, were cut in the sandstone, and twelve others, five inches wide, and twelve inches deep, in the limestone. In November, 1825, one live toad was placed in each of the twenty-four cells, its weight being previously ascertained with care. A glass plate was placed over each cell as a cover, with a circular slate above to protect it; and the two blocks of stone, with the immured toads, were buried in Dr Buckland's garden under three feet of earth. They were uncovered after the lapse of a year, in December, 1826. All the toads in the small cells of compact sandstone were dead, and their bodies so much decayed as to prove that they had been dead for some months. The greater number of the toads in the larger cells of porous limestone were alive; but they were all a good deal emaciated, except two, which had increased in weight, the one from one thousand one hundred and eighty-five grains to one thousand two hundred and sixty-five, the other from nine hundred and eighty-eight to one thousand one hundred and sixteen. With regard to these two, Dr Buckland thinks they had both been nourished by insects, which had got into the one cell through a crack found in the glass cover, and into the other probably by some small aperture in the luting, which was not carefully examined. No insects were found in either cell, but an assemblage of insects were found on the outside of another glass, and a number within one of the cells whose cover was cracked, and where the animal was dead. Of the emaciated toads, one had diminished in weight from nine hundred and twenty-four grains to six hundred and ninety-eight, and one from nine hundred and thirty-six to six hundred and fifty-two. "The results of the experiments," says Dr Buckland, "amount to this:—All the toads, both large and small, enclosed in the sandstone, and the small toads inclosed in the limestone also, were dead at the end of thirteen months. Before the expiration of the second year, all the large ones also were dead. These were examined several times, during the second year, through the glass covers of the cells, but without removing them to admit air. They appeared always awake, with their eyes open, and never in a state of torpor, their meagerness increasing at each interval, until at length they were found dead. Those which had gained an increase of weight at the end of the first year, and were then carefully closed up again, were emaciated and dead before the expiration of the second year." Four toads, inclosed in cavities cut in the trunk of an apple tree, and closed up by plugs so tightly as to exclude insects, and "apparently air," were found dead at the end of a year.

The phenomena, then, of live toads inclosed in rocks, he explains in this way. The young toad, as soon as it leaves its tadpole state, and emerges from the water, seeks shelter in holes and crevices of rocks and trees. One may thus enter a small opening in a rock, and when there find food, by catching the insects which seek shelter in the same retreat; and its increase of size may prevent it from getting out again by the same opening. It is probable that there are some small apertures in all the stones in which toads are found, though they escape the notice of the workmen, who have no motive to induce them to make a narrow examination. In other cases, there may have been an opening, which had been closed up, after the animal was immured, by stalactitic incrustation. Deprived of food and air, it might fall into that state of torpor, or suspended animation, to which certain animals are subject in winter; but how long it might continue in this state is uncertain.

The Rev. George Young, in his *Geological Survey of the Yorkshire Coast*, second edition, 1828, mentions several recent instances of living toads having been found within solid blocks of sandstone. "We are the more particular in recording these facts," he observes, "because some modern philosophers have attempted to explode such accounts as wholly fabulous." Mr Jesse informs us, that he knew a gentleman who put a toad into a small flower-pot, and secured it, so that no insect could penetrate it, and then buried it so deep in his garden that it was secured against the influence of frost. At the end of twenty years he took it up, and found the toad increased in bulk, and healthy.

this is in a letter to the bishop of Carlisle from Dr Pitfield, who was the first person of consequence that attended the experiment. His letter is as follows:—

"Your lordship must have taken notice of a paragraph in the papers with regard to the application of toads to a cancered breast. A patient of mine has sent to the neighbourhood of Hungerford, and brought down the very woman on whom the cure was done. I have, with all the attention I am capable of, attended the operation for eighteen or twenty days, and am surprised at the phenomenon. I am in no expectation of any great service from the application; the age, constitution, and thoroughly cancerous condition, of the person, being unconquerable barriers to it. How an aliment of that kind, absolutely local, in an otherwise sound habit, and of a likely age, might be relieved, I cannot say. But as to the operation, thus much I can assert, that there is neither pain nor nauseousness in it. The animal is put into a linen bag all but its head, and that is held to the part. It has generally instantly laid hold of the foulest part of the sore, and sucked with greediness until it dropped off dead. It has frequently happened that the creature has swollen immediately, and from its agonies, appeared to be in great pain. I have weighed them for several days together, before and after the application, and found their increase of weight, in the different degrees, from a drachm to near an ounce. They frequently sweat exceedingly, and turn quite pale, sometimes they disgorge, recover, and become lively again: I think the whole scene is surprising, and a very remarkable piece of natural history. From the constant inoffensiveness which I have observed in them, I almost question the truth of their poisonous spitting. Many people here expect no great good from the application of toads to cancers; and where the disorder is not absolutely local, none is to be expected. When it is seated in any part not to be well come at for extirpation, I think it is hardly to be imagined, but that the having it sucked clean as often as you please, must give great relief. Every body knows that dogs licking of sores cures them; which is, I suppose, chiefly by keeping them clean. If there be any credit to be given to history, poisons have been sucked out. *Pallentia vulnera lambit ore venena trahens*, are the words of Lucan on the occasion. If the people to whom these words are applied did their cure by immediately following the injection of the poison, the local confinement of another poison brings the case to a great degree of similarity. I hope I have not tired your lordship with my long tale: as it is a true one, and, in my apprehension, a curious piece of natural history, I could not forbear communicating it to you. I own I thought the story in the papers to be an invention; and when I considered the instinctive principle in all animals of self-preservation, I was confirmed in my disbelief; but what I have related I saw; and all theory must yield to fact. It is only the Rubeta, the land-toad, which has the property of sucking: I cannot find any, the least, mention of the property in any one of the old naturalists. My patient can bear to have but one applied in twenty-four hours. The woman who was cured had them on day and night, without intermission, for five weeks. Their time of hanging at the breast has been from one to six hours."

Other remarks made upon their method of performing this extraordinary operation are as follow: "Some toads die very soon after they have sucked; others live about a quarter of an hour, and some much longer. For example, one that was applied about seven o'clock sucked till ten, and died as soon as it was taken from the breast; another that immediately succeeded continued till three o'clock, but dropped dead from the wound: each swelled exceedingly, and grew of a pale colour. They do not seem to suck greedily, and often turn their heads away; but during the time of their sucking, they were heard to smack their lips like a young child."[1]

From this circumstantial account of the progress of this extraordinary application, one could hardly suppose that any doubt could remain of the ingenious observer's accuracy; and yet, from information which I have received from authority still more respectable, there is much reason, as yet, to suspend our assent. A lady, who was under the care of the present president of the College of Physicians, was induced by her friends to try the experiment; and as he saw the case was desperate, and that it would quiet her mind as well as theirs, he permitted the trial. During the whole continuance of their application, she could never thoroughly perceive that they sucked her; but that did not prevent their swelling and dying, as in the former instances. Once indeed, she said, she thought that one of them seemed to suck; but the physician, and those who attended, could not perceive any appearance of it. Thus, after all, it is a doubt whether these animals die by the internal or the external application of the cancerous poison.

Of this animal there are several varieties; such as the water and the land toad, which probably differ only in the ground-colour of their skin. In the first, it is more inclining to ash-colour, with brown spots; in the other, the colour is brown, approaching to black.

[1] British Zoology, vol. iii. p. 338.

The water toad is not so large as the other; but both equally breed in that element. The size of the toad, with us, is generally from two to four inches long; but in the fenny countries of Europe I have seen them much larger, and not less than a common crab, when brought to table. But this is nothing to what they are found in some of the tropical climates, where travellers often, for the first time, mistake a toad for a tortoise. Their usual size is from six to seven inches: but there are some still larger, and as broad as a plate. Of these some are beautifully streaked and coloured; some studded over, as with pearls; others bristled with horns or spines; some have the head distinct from the body, while others have it so sunk in that the animal appears without a head.[1] All these are found in the tropical climates in great abundance; and particularly after a shower of rain. It is then that the streets seem entirely paved with them; they then crawl from their retreats, and go into all places to enjoy their favourite moisture. With us the opinion of its raining toads and frogs has long been justly exploded; but it still is entertained in the tropical countries; and that not only by the savage natives, but the more refined settlers, who are apt enough to add the prejudices of other nations to their own.

It would be a tedious, as well as useless task, to enter into all the minute discriminations of these animals, as found in different countries or places; but the *pipa*, or *Surinam toad*, is too strange a creature not to require



an exact description. There is not, perhaps, in all nature, a more extraordinary phenomenon than that of an animal breeding and hatching its young in its back; from whence, as from a kind of hot-bed, they crawl one after the other when come to maturity.

The pipa is, in form, more hideous than even the common toad; nature seeming to have marked all those strange mannered animals with peculiar deformity. The body is flat and broad; the head small; the jaws, like those of a mole, are extended, and evidently formed for rooting in the ground: the skin of the neck forms a sort of wrinkled collar: the colour of the head is of a dark chestnut, and the eyes are small: the back, which is very broad, is of a lightish gray, and seems covered over with a number of small eyes, which are round, and placed at nearly equal distances. These eyes are very different from what they seem; they are the animal's eggs, covered with their shells, and placed there for hatching. These eggs are buried deep in the skin, and in the beginning of incubation but just appear; and are very visible when the young animal is about to burst from its confinement. They are of a reddish shining yellow colour; and the spaces between them are full of small warts resembling pearls.[2]

This is their situation, previous to their coming forth; but nothing so much demands our admiration as the manner of their production. The eggs, when formed in the ovary, are sent by some internal canals, which anatomists have not hitherto described to lie, and come to maturity, under the bony substance of the back; in this state they are impregnated by the male, whose seed finds its way by pores very singularly contrived, and pierces not only the skin but the periosteum. The skin, however, is still apparently entire, and forms a very thick covering over the whole brood; but as they advance to maturity, at different intervals, one after another, the egg seems to start forward and bourgeon from the back, becomes more yellow, and at last breaks, when the young one puts forth its head: it still, however, keeps its situation, until it has acquired a proper degree of strength, and then it leaves the shell, but still continues to keep upon the back of the parent. In this manner the pipa is seen travelling with her wondrous family on her back, in all the different stages of maturity. Some of the strange progeny, not yet come to sufficient perfection, appear quite torpid, and as yet without life in the egg: others seem just beginning to rise through the skin; here peeping forth from the shell; and there, having entirely forsaken their prison; some are sporting at large upon the parent's back; and others descending to the ground, to try their own fortune below.

Such is the description given of this strange

[1] Among this numerous family there is one which, for horrid and deformed appearance, probably, exceeds all other created beings. This is the horned toad, of South America. The colour is cinereous, with brown stripes. The eye-lids project in a singular manner, and give it the appearance as if the eyes were placed at the bottom of a pair of sharp pointed horns: the head is very large, and the mouth is so enormous, as to exceed half the length of its body. To add to its lothesome appearance, it is likewise clothed all over, except the head and feet, with short sharp spines.

[2] It is now demonstrated that the female lays its eggs after the manner of toads, but that the male, fastened on her back, fecundates them, and then places them on the back of the mother; she then repairs to the water, where her skin swells, and forms rounded alveoli, in which these eggs are lodged, to be subsequently disclosed. The pipa lives in the fresh waters of South America, and sometimes in the obscure parts of houses at Cayenne and Surinam. The negroes are said sometimes to use the pipa as food.

production by Seba, in which he differs from Ruysch, who affirms, that the young ones are bred in the back of the male only, where the female lays her eggs. I have followed Seba, however, not because he is better authority, but because he is more positive of the truth of his account, and asserts, assuredly, that the eggs are found on the back of the female only. Many circumstances, however, are wanting towards completing his information; such as a description of the passage by which the egg finds its way into the back; the manner of its fecundation; the time of gestation; as also a history of the manners of this strange animal itself; but, by a prolixity that much prevails among naturalists at present, he leaves the most interesting object of curiosity to give us a detailed description of the legs and claws of the pipa, about which we have very little concern.

The male pipa is every way larger than the female, and has the skin less tightly drawn round the body. The whole body is covered with pustules resembling pearls; and the belly, which is of a bright yellow, seems as if it were sewed up from the throat to the vent, a seam being seen to run in that direction. This animal, like the rest of the frog kind, is most probably harmless; though we are told of the terrible effects resulting from its powder when calcined. This, however, must certainly be false; no creature whatever, when calcined, can be poisonous; for the fire burns away whatever might have been dangerous in their composition: all animal substances, when calcined, being entirely the same.

OF FROGS, LIZARDS, AND SERPENTS.

BOOK II.

OF LIZARDS.

CHAP. I.

OF LIZARDS IN GENERAL.

There is scarcely a naturalist, who has treated of lizards, but has a particular manner of ranking them in the scale of animated nature. Ray, rather struck with the number of their legs than their habits and conformation, has exalted them among quadrupeds; while Linnæus, attentive only to their long slender forms, has degraded them among serpents. Brisson gives them a distinct class by themselves, under the name of *reptiles*. Klein gives them a class inferior to beasts, under the name of *naked quadrupeds*. Some, in short, from their scaly covering, and fondness for the water, have given them to the fishes; while there have not been wanting naturalists who have classed them with insects, as the smaller kinds of this class seem to demand.

It is indeed no easy matter to tell to what class in nature lizards are chiefly allied. They are unjustly raised to the rank of beasts, as they bring forth eggs, dispense with breathing, and are not covered with hair. They cannot be placed among fishes, as the majority of them live upon land: they are excluded from the serpent tribe by their feet, upon which they run with some celerity: and from the insects, by their size; for though the Newt may be looked upon in this contemptible light, a Crocodile would be a terrible insect indeed. Thus lizards are, in some measure, excluded from every rank, while they exhibit somewhat of the properties of all; the legs and celerity of the quadruped; a facility of creeping through narrow and intricate ways, like the serpent; and a power of living in the water, like fishes; however, though endued with these various powers, they have no real advantages over any other class of animated nature; for what they gain in aptitude for one element, they lose in their fitness for another. Thus, between both, they are an awkward ungainly tribe; neither so alert upon land, nor so nimble in the water, as the respective inhabitants of either abode: and, indeed, this holds throughout all nature, that in proportion as the seeming advantages of inferior animals are multiplied, their real ones are abridged; and all their instincts are weakened and lost by the variety of channels into which they are divided.

As lizards thus differ from every other class of animals, they also differ widely from each other. With respect to size, no class of beings has its ranks so opposite. What, for instance, can be more removed than the small cameleon, an inch long, and the alligator of the river Amazon, above twenty-seven feet? To an inattentive observer, they would appear entirely of different kinds; and Seba wonders how they ever came to be classed together.

The colour of these animals also is very various, as they are found of a hundred different hues—green, blue, red, chestnut, yellow, spotted, streaked, and marbled. Were colour alone capable of constituting beauty, the lizard would often please; but there is something so repressing in the animal's figure, that the brilliancy of its scales, or the variety of its spots, only tend to give an air of more exquisite venom or greater malignity. The figure of these animals is not less various; sometimes swollen in the belly; sometimes pursed up at the throat; sometimes with a rough set of spines on the back, like the teeth of a saw; sometimes with teeth, at others with none; sometimes venomous, at others harmless, and even philanthropic: sometimes smooth and even; sometimes with a long slender tail; and often with a shorter blunt one.[1]

[1] The whole of this tribe is perfectly destitute of poi-

But their greatest distinction arises from the manner of bringing forth their young. First, some of them are viviparous. Secondly, some are oviparous; and which may be considered in three distinct ways. Thirdly, some bring forth small spawn, like fishes. The crocodile, the iguana, and all the larger kinds, bring forth eggs, which are hatched by the heat of the sun; the animals that issue from them are complete upon leaving the shell; and their first efforts are to run to seek food in their proper element. The viviparous kinds, in which are all the salamanders, come forth alive from the body of the female, perfect and active, and suffer no succeeding change. But those which are bred in the water, and as we have reason to think, from spawn, suffer a very considerable change in their form. They are produced with an external skin or covering that sometimes incloses their feet, and gives them a serpentine appearance. To this false skin fins are added, above and below the tail, that serve the animal for swimming; but when the false skin drops off, these drop off also; and then the lizard, with its four feet, is completely formed, and forsakes the water.

From hence it appears, that, of this tribe, there are three distinct kinds, differently produced, and, most probably, very different in their formation. But the history of these animals is very obscure; and we are, as yet, incapable of laying the line that separates them. All we know, as was said before, is, that the great animals of this kind are *mostly* produced perfect from the egg; the salamanders are *generally* viviparous; and *some* of the water lizards imperfectly produced. In all these most unfinished productions of Nature, if I may so call them, the varieties in their structure increase in proportion to their imperfections. A poet would say, that Nature grew tired of the nauseous formation, and left accident to finish the rest of her handy-work.

However, the three kinds have many points of similitude; and, in all their varieties of figure, colour, and production, this tribe is easily distinguished, and strongly marked. They have all four short legs; the two forefeet, somewhat resembling a man's hand and arm. They have tails almost as thick as the body at the beginning, and that generally run tapering to a point. They are all amphibious also; equally capable of living upon land and water; and formed, internally, in the same manner with the tortoise, and other animals, that can continue a long time without respiration: in other words, their lungs are not so necessary to continue life and circulation, but that their play may be stopped for some considerable time, while the blood performs its circuit round the body by a shorter communication.

These are differences that sufficiently separate lizards from all other animals; but it will be very difficult to fix the limits that distinguish the three kinds from each other. The *crocodile* tribe, and its affinities, are sufficiently distinguished from all the rest by their size and fierceness; the *salamander* tribe is distinguished by their deformity, their frog-like heads, the shortness of their snouts, their swollen bellies, and their viviparous production. With regard to the rest, which we may denominate the cameleon or lizard kind, some of which bring forth from the egg, some of which are imperfectly formed from spawn, we must group them under one head, and leave time to unravel the rest of their history.

son, and except the crocodile and alligator, quite inoffensive to mankind. Those that are bred in waters undergo a metamorphosis, and pass through a tadpole form.

CHAP. II.

OF THE CROCODILE, AND ITS AFFINITIES [1]

The Crocodile is an animal placed at a happy distance from the inhabitants of Europe, and formidable only in those regions where men are scarce, and arts are but little known. In all the cultivated and populous

[1] *Crocodiles and Alligators.*—The *true crocodile* is found in the river Nile, but by no means in such plenty as in the times of the Pharaohs. The species which is domesticated by the priests, and magnificently provided for in a temple in Memphis, was of a green colour. It was an object of profound worship, called a God, and embalmed when it died. On the other hand, the *alligator* is exclusively found in America; and instead of having an uninterrupted series of teeth round both jaws, as in the crocodile, the fourth tooth of the under jaw shuts into a corresponding socket in the upper one. This law is so universal, that any person by remembering this fact, may with certainty designate the one from the other.

The term *alligator* is applied to the various species of crocodiles that are found in America, while the name *Gavial* has been given to such as inhabit the East Indies and the islands of the Indian ocean, and the original word is more especially used when speaking of that species which abounds in the Nile. In the central parts of Africa, the crocodiles attain a very large size, in many instances being found as much as thirty feet in length.

The crocodile swallows its prey whole, and feeds indifferently on fish or small quadrupeds; and the upper teeth, instead of resting with their points upon the under when the mouth is closed, enter between them, and thus prevent all chance of escape. It but rarely attacks mankind. On either side of the under part of the lower jaw, a small opening is found, from which the creature can force, at will, a liquid possessing the smell of musk. This property has been lately noticed by Mr Thomas Bell, in a paper inserted in the *Transactions of the Royal Society of London*, and, in his opinion, the reptile employs it for the purpose of attracting fish into the places it haunts.

parts of the world, the great animals are entirely banished, or rarely seen. The appearance of such raises at once a whole country up in arms to oppose their force; and their lives generally pay the forfeit of their temerity. The crocodile, therefore, that was once so terrible along the banks of the river Nile, is now neither so large, nor its numbers so great

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The following cut represents *the Double Crested Crocodile*. It is the most common species in all the rivers



that lead to the Indian ocean. It is found in Java and even in China.

The most remarkable distinguishing character of alligators (as already said) is the shape of the head. The gavials have it the most produced, the crocodiles the next, and the alligators have it shortest. In them the length of the jaws from the articulation is only one-half more than the greatest breadth. The teeth have a ragged appearance, as some of them are long and others short. There are never fewer than nineteen in each side of either jaw, and sometimes two more in each side of the under one. These grow with the growth of the animal; and receiving cavities are formed for them in the upper jaw, especially from those fourth from the front, which are longer than any of the others. The body is low and squat; the hind legs are nearly round in their section, and have no membrane on their sides; the webs of the toes also extend only half the length; and the holes behind the orbits, which are understood to secrete a musky fluid in the crocodiles, are small and obscure, or wanting. From the structure of the feet, and the want of fringed or pectinated membranes on the hind legs, which are both a lessening of the pelagic structure, alligators keep more to the fresh waters, the rivers, and lagunes, than the crocodiles; so that those in the bays of the West India islands, though popularly known as alligators or *caymans*, are rather to be considered as crocodiles, even in the popular sense of that term.

There are four species or more, of alligators, all natives of the warmer parts of the American continent, but varying in their appearance, so as in some of the species to resemble the crocodiles, and in others the gavials. The species which, in the written accounts at least, is the most ferocious and formidable to man, is that which inhabits the Mississippi and the other rivers of the southern parts of North America, and the swamps and lagunes which these rivers form when they are swollen by floods. It is the *pike-headed alligator* (*Alligator lucius*) of Cuvier,



so called because its head, in shape at least, bears some resemblance to that of the common pike. This species has been seen as long as fifteen feet, with the head two feet long, and the gape nearly the same. The jaws are more elongated than in some other species, the breadth at the articulation not being in those of the size mentioned much more than one foot. The snout is flattened on the upper surface, and slightly turned up at the extremity, which is bluntly pointed; but the sides of the jaws are, for the greater portion of the length of the gape, nearly parallel. The teeth are large and irregular, with the fourth from the front in each side of the under jaw much larger than the rest, so that they can penetrate through a substance of considerable thickness, and, with their points received into the sockets in the upper jaw, hold on against a very considerable strain. It is by this means that the animal is said to master the larger mammalia, when they come to the shores to quench their thirst. The alligator, having observed its prey, swims slowly towards it, with the snout barely above the water. When within reach, it seizes the upper lip and nose; and at the same time incurvating its body with more than ordinary exertion, hits a violent blow on the shoulder with its thick and scaly tail. The bite and the blow together bring the animal to its knees, tumble it headlong and helpless; and as the alligator does not quit its hold while the animal continues to struggle, and also contrives to keep the head under water, the prey soon expires of pain and suffocation. The smaller mammalia are generally foundered by the blow of the tail, and then seized by the head and drawn under water till they are suffocated. But in what state soever prey of this description is eaten, whether recent or after it has been partially decomposed by time, it is always eaten on land. They do not feed under water, any more than they breathe in that situation.

The *Varied Monitor*, of which the following is a representation, resembles the crocodile as to form, but is



different in its habits. It swims with difficulty, runs with considerable swiftness, and climbs trees with dexterity. It conceals itself in burrows, and bites desperately. Its flesh and eggs are eaten. Its length is from four to five feet. It inhabits the savannahs and marshy soils of South America, particularly Guiana.

There is, perhaps, no country in which the alligator more generally abounds, than in India. It is found in most of the rivers, in the large tanks, and frequently, during the monsoons, in small pools of water scarcely larger than the common pond of an English farm-yard. In the larger tanks these creatures are commonly fed by the Hindoos, who venerate, though they do not, like the ancient Egyptians, worship them. They become so tame when daily supplied with food by the superstitious Brahmins of the temples near which they take up their undisturbed abode, that any person may fearlessly bathe in the tanks, without the slightest chance of molestation, these usually voracious reptiles being so pampered, as to have no further relish for human flesh.

In the Ganges, these creatures may be almost daily seen watching the numerous carcasses which constantly float down that river, awaiting the moment when they shall have attained a state of luxurious maturity. Sometimes a solitary vulture appears sailing down the current,

as formerly. The arts of mankind have, through a course of ages, powerfully operated to its destruction; and, though it is sometimes seen, it appears comparatively timorous and feeble.

To look for this animal in all its natural terrors, grown to an enormous size, propagated in surprising numbers, and committing unceasing devastations, we must go to the uninhabited regions of Africa and America, to

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perched upon a human body, which the mistaken attachment of superstitious friends had committed to the stream to send on its roads to paradise, tearing the scarcely cold flesh from the bones, until chased from its horrid repast by the more dominant and not less voracious alligator.

It is a very common thing for the native princes of India, living in the neighbourhood of large rivers where alligators abound, to have them caught for the purpose of entertaining their court and guests, by making them fight, or causing them to be attacked by other animals. Captain Basil Hall has given the following animated account of a fight of this kind, got up for the amusement of the Admiral, Sir R. Hood, and performed by a corps of Malays in the British service.

Very early (he says) in the morning, the party were summoned from their beds, to set forth on the expedition. In other countries, the hour of getting up may be left to choice; in India, when any thing active is to be done, it is a matter of necessity; for after the sun has gained even a few degrees of altitude, the heat and discomfort, as well as the danger of exposure, become so great, that all pleasure is at an end. The day, therefore, had scarcely begun to dawn, when we all cantered up to the scene of action.

The ground lay as flat as a marsh for many leagues, and was spotted with small stagnant lakes connected by sluggish streams, scarcely moving over beds of mud, between banks fringed with a rank crop of draggled weeds. The chill atmosphere of the morning felt so thick and clammy, it was impossible not to think of agues, jungle-fevers, and all the hopeful family of malaria. The hardy native soldiers who had occupied the ground during the night, were drawn up to receive the Admiral, and a very queer guard of honour they formed. The whole regiment had stripped off their uniform, and every other stitch of clothing, save a pair of short trousers, and a kind of sandal. In place of a firelock, each man bore in his hand a slender pole, about six feet in length, to the extremity of which was attached the bayonet of his musket. His only other weapon, was the formidable Malay crease, a sort of dagger, or small two-edged sword.

Soon after the commander-in-chief came to the ground, the regiment was divided into two main parties, and a body of reserves. The principal columns, facing, one to the right, the other to the left, proceeded to occupy different points in one of the sluggish canals, connecting the pools scattered over the plain. These detachments being stationed about a mile from one another, enclosed an interval where, from some peculiar circumstances known only to the Malays, who are passionately fond of the sport, the alligators were sure to be found in great numbers. The troops formed themselves across the canals, in three parallel lines, ten to twelve feet apart; but the men in each line stood side by side, merely leaving room enough to wield their pikes. The canal may have been about four or five feet deep, in the middle of the stream, if stream it can be called, which scarcely moved at all. The colour of the water, when undisturbed, was a shade between ink and coffee; but no sooner had the triple line of Malays set themselves in motion, than the consistence and colour became like those of peas-soup.

On every thing being reported ready, the soldiers planted their pikes before them in the mud, each man crossing his neighbour's weapon, and at the word "march" away they all started in full cry, sending forth a shout, or war-whoop, sufficient to curdle the blood of those on land, whatever effect it may have had on the inhabitants of the deep. As the two divisions of the invading army gradually approached each other in pretty close column, screaming, and yelling, and striking their pikes deep in the slime before them, the startled animals naturally retired towards the unoccupied centre. Generally speaking, the alligators, or crocodiles, had sense enough to turn their long tails upon their assailants, and to scuttle off, as fast as they could, towards the middle part of the canal. But every now and then, one of the terrified monsters floundered backwards, and, by retreating in the wrong direction, broke through the first, second, and even third line of pikes. This was the perfection of sport to the delighted Malays. A double circle of soldiers was speedily formed round the wretched aquatic who had presumed to pass the barrier. By means of well-directed thrusts with numberless bayonets, and the pressure of some dozens of feet, the poor brute was often fairly driven beneath his native mud. When once there, his enemies half-choked and half-spitted him, till at last they put an end to his miserable days, in regions quite out of sight, and in a manner as inglorious as can well be conceived.

The intermediate space was now pretty well crowded with alligators, swimming about in the utmost terror, at times diving below, and anon showing their noses above the surface of the dirty stream; or occasionally making a furious bolt, in sheer despair, right at the phalanx of Malays. On these occasions, half-a-dozen of the soldiers were often upset, and their pikes either broken or twisted out of their hands, to the infinite amusement of their companions, who speedily closed up the broken ranks. There were none killed, but many wounded; yet no man flinched in the least.

The perfection of the sport appeared to consist in detaching a single alligator from the rest, surrounding and attacking him separately, and spearing him till he was almost dead. The Malays, then, by main strength, forked him aloft, over their heads, on the end of a dozen pikes, and, by a sudden jerk, pitched the conquered monster far on the shore. As the alligators are amphibious, they kept to the water no longer than they found they had an advantage in that element; but on the two columns of their enemy closing up, the monsters lost all discipline, floundered up the weedy banks, scuttling away to the right and left, helter-skelter. "Sauve qui peut!" seemed to be the fatal watch-word for their total rout. That prudent cry would, no doubt, have saved many of them, had not the Malays judiciously placed beforehand their reserve on each side of the river, to receive the distracted fugitives, who, bathed in mud, and half dead with terror, but still in a prodigious fury, dashed off at right angles from the canal, in hopes of gaining the shelter of a swampy pool, overgrown with reeds and bulrushes, but which most of the poor beasts were never doomed to reach. The concluding battle between these retreating and desperate alligators, and the Malays of the reserve, was formidable enough. Indeed, had not the one party been fresh, the other exhausted, one confident, the other broken in spirit; it is quite possible that the crocodiles might have worsted the Malays. It was difficult, indeed, to say which of the two looked at that moment the more savage; the triumphant natives, or the flying troop of alligators wallopping away from the water. Many on both sides were wounded, and all covered with slime and weeds. There could not have been fewer than thirty or forty alligators killed. The

those immense rivers that roll through extensive and desolate kingdoms, where arts have never penetrated, where force only makes distinction, and the most powerful animals exert their strength with confidence and security. Those that sail up the river Amazon, or the river Niger, well know how numerous and terrible those animals are in such parts of the world. In both these rivers, they are found from eighteen to twenty-seven feet long; and sometimes lying as close to each other as rafts of timber upon one of our streams. There they indolently bask on the surface, no way disturbed at the approach of an enemy, since, from the repeated trials of their strength, they found none that they were not able to subdue.

Of this terrible animal there are two kinds; the Crocodile, properly so called, and the Cayman or Alligator. Travellers, however, have rather made the distinctions than Nature; for in the general outline, and in the nature of these two animals, they are entirely the same. It would be speaking more properly to call these animals the Crocodiles of the eastern and western world; for, in books of voyages, they are so entirely confounded together, that there is no knowing whether the Asiatic animal be the crocodile of Asia, or the alligator of the western world. The distinctions usually made between the crocodile and alligator are these: the body of the crocodile is more slender than that of the alligator; its snout runs off tapering from the forehead, like that of a grayhound; while that of the other is indented, like the nose of a lapdog. The crocodile has a much wider swallow, and is of an ash-colour; the alligator is black, varied with white, and is thought not to be so mischievous. All these distinctions, however, are very slight; and can be reckoned little more than minute variations.

This animal grows to a great length, being sometimes found thirty feet long, from the tip of the snout to the end of the tail; its most usual length, however, is eighteen. One which was dissected by the Jesuits at Siam, was of the latter dimensions; and the description which is given of it, both externally and internally, is the most accurate known of this noted animal. I must beg leave to give it as I find it, though somewhat tedious. It was eighteen feet and a half, French measure, in length; of which the tail was no less than five feet and a half, and the head and neck above two feet and a half. It was four feet nine inches in circumference, where thickest. The fore legs had the same parts and conformation as the arms of a man, both within and without. The hands, if they may be so called, had five fingers; the two last of which had no nails, and were of a conical figure. The hinder legs, including the thigh and paw, were two feet two inches long; the paws, from the joint to the extremity of the longest claws, were above nine inches; they were divided into four toes, of which three were armed with large claws, the longest of which was an inch and a half; these toes were united by a membrane, like those of a duck, but much thicker. The head was long, and had a little rising at the top; but the rest was flat, and especially towards the extremity of the jaws. It was covered by a skin, which adhered firmly to the skull and to the jaws. The skull was rough and unequal in several places; and about the middle of the forehead there were two bony crests, about two inches high: the skull between these two crests was proof against a musket-ball; for it only rendered the part a little white that it struck against. The eye was very small, in proportion to the rest of the body, and was so placed within its orbit, that the outward part, when the lid was closed, was only an inch long, and the line running parallel to the opening of the jaws. It was covered with a double lid, one within and one without: that within, like the nictitating membrane in birds, was folded in the great corner of the eye, and had a motion towards the tail, but being transparent, it covered the eye without hindering the sight. The iris was very large in proportion to the globe of the eye, and was of a yellowish gray colour. Above the eye the ear was placed, which opened from above downwards, as if it were by a kind of spring, by means of a solid, thick, cartilaginous substance. The nose was placed in the middle of the upper jaw, near an inch from its extremity, and was perfectly round and flat, being near two inches in diameter, of a black, soft, spongy substance, not unlike the nose of a dog. The jaws seemed to shut one within another; and nothing can be more false than that the animal's under jaw is without motion; it moves like the lower jaw in all other animals, while the upper is fixed to the skull, and absolutely immovable. The animal had twenty-seven cutting teeth in the upper jaw, and fifteen in the lower, with several void spaces between them: they were thick at the bottom, and sharp at the point, being all of different sizes, except ten large hooked ones, six of which were in the lower jaw, and four in the upper. The mouth was fifteen inches in length, and eight and a half in breadth, where broadest. The distance of the two jaws, when opened

largest measured ten feet in length, and four feet girth, the head being exactly two feet long. Besides these great fellows, a multitude of little ones, nine inches long, were caught alive, many of which, being carried on board, became great favourites amongst the sailors, whose queer taste in the choice of pets has frequently been noticed.

as wide as they could be, was fifteen inches and a half; this is a very wide yawn, and could easily enough take in the body of a man. The colour of the body was of a dark brown on the upper part, and of a whitish citron below, with large spots of both colours on the sides. From the shoulders to the extremity of the tail, the animal was covered with large scales, of a square form, disposed like parallel girdles, and fifty-two in number; but those near the tail were not so thick as the rest. The creature was covered not only with these, but all over with a coat of armour; which, however, was not proof against a musket-ball, contrary to what has been commonly asserted: however, it must be confessed, that the attitude in which the animal was placed, might contribute to render the skin more penetrable; for, probably, if the ball had struck obliquely against the shell it would have flown off. Those parts of the girdles underneath the belly were of a whitish colour, and were made up of scales of divers shapes, but not so hard as those on the back.

With respect to the internal parts of the animal, the gullet was large in proportion to the mouth; and a ball of wood, as large as one's head, readily ran down, and was drawn up again. The guts were but short, in comparison, being not so long as the animal's body. The tongue, which some have erroneously asserted this animal was without, consisted of a thick, spongy, soft flesh, and was strongly connected to the lower jaw. The heart was of the size of a calf's, of a bright red colour, the blood passing as well from the veins to the aorta as into the lungs. There was no bladder; but the kidneys sent the urine to be discharged by the anus. There were sixty-two joints in the back-bone, which, though very closely united, had sufficient play to enable the animal to bend like a bow to the right and the left; so that what we hear of escaping the creature by turning out of the right line, and of the animal not being able to wheel readily after its prey, seems to be fabulous. It is most likely the crocodile can turn with ease, for the joints of its back are not stiffer than those of other animals, which we know, by experience, can wheel about very nimbly for their size.

Such is the figure and conformation of this formidable animal, that unpeoples countries, and makes the most navigable rivers desert and dangerous. They are seen, in some places, lying for whole hours, and even days, stretched in the sun, and motionless; so that one not used to them might mistake them for trunks of trees, covered with a rough and dry bark; but the mistake would soon be fatal, if not prevented; for the torpid animal, at the near approach of any living thing, darts upon it with instant swiftness, and at once drags it down to the bottom. In the times of inundation, they sometimes enter the cottages of the natives, where the dreadful visitant seizes the first animal it meets with. There have been several examples of their taking a man out of a canoe in the sight of his companions, without their being able to lend him any assistance.

The strength of every part of the crocodile is very great; and its arms, both offensive and defensive, irresistible. We have seen, from the shortness of its legs, the amazing strength of the tortoise: but what is the strength of such an animal compared to that of the crocodile, whose legs are very short, and whose size is so superior! The back-bone is jointed in the firmest manner; the muscles of the fore and hinder legs are vigorous and strong; and its whole form calculated for force. Its teeth are sharp, numerous, and formidable; its claws are long and tenacious; but its principal instrument of destruction is the tail: with a single blow of this it has often overturned a canoe, and seized upon the poor savage its conductor.

Though not so powerful, yet it is very terrible even upon land. The crocodile seldom, except when pressed by hunger, or with a view of depositing its eggs, leaves the water. Its usual method is to float along upon the surface, and seize whatever animals come within its reach; but when this method fails, it then goes closer to the bank. Disappointed of its fishy prey, it there waits, covered up among the sedges, in patient expectation of some land animal that comes to drink; the dog, the bull, the tiger, or man himself. Nothing is to be seen of the insidious destroyer as the animal approaches; nor is its retreat discovered, till it be too late for safety. It seizes the victim with a spring, and goes at a bound much farther than so unwieldly an animal could be thought capable of exerting; then having secured the creature with both teeth and claws, it drags it into the water, instantly sinks with it to the bottom, and in this manner quickly drowns it.

Sometimes it happens that the creature the crocodile has thus surprised escapes from its grasp wounded, and makes off from the river side. In such a case the tyrant pursues with all its force, and often seizes it a second time; for, though seemingly heavy, the crocodile runs with great celerity. In this manner it is sometimes seen above half a mile from the bank, in pursuit of an animal wounded beyond the power of escaping, and then dragging it back to the river-side, where it feasts in security.

It often happens, in its depredations along the bank, that the crocodile seizes on a crea-

ture as formidable as itself, and meets with a most desperate resistance. We are told of frequent combats between the crocodile and the tiger. All creatures of the tiger kind are continually oppressed by a parching thirst, that keeps them in the vicinity of great rivers, whither they descend to drink very frequently. It is upon these occasions that they are seized by the crocodile; and they die not unrevenged. The instant they are seized upon, they turn with the greatest agility, and force their claws into the crocodile's eyes, while he plunges with his fierce antagonist into the river. There they continue to struggle for some time, till at last the tiger is drowned.

In this manner the crocodile seizes and destroys all animals, and is equally dreaded by all. There is no animal but man alone that can combat it with success. We are assured by Labat, that a negro, with no other weapons than a knife in his right hand, and his left arm wrapped round with a cow-hide, ventures boldly to attack this animal in his own element. As soon as he approaches the crocodile, he presents his left arm, which the animal swallows most greedily; but sticking in his throat, the negro has time to give it several stabs under the throat; and the water also getting in at the mouth, which is held involuntarily open, the creature is soon bloated up as big as a tun, and expires.

To us who live at a distance from the rapacity of these animals, these stories appear strange, and yet most probably are true. From not having seen any thing so formidable or bold in the circle of our own experience, we are not to determine upon the wonderful transactions in distant climates. It is probable that these, and a number of more dreadful encounters, happen every day among those forests and in those rivers where the most formidable animals are known to reside; where the elephant and rhinoceros, the tiger and the hippopotamus, the shark and the crocodile, have frequent opportunities of meeting, and every day of renewing their engagements.

Whatever be the truth of these accounts, certain it is that crocodiles are taken by the Siamese in great abundance. The natives of that empire seem particularly fond of the capture of all the great animals with which their country abounds. We have already seen their success in taking and taming the elephant; nor are they less powerful in exerting their dominion over the crocodile. The manner of taking it in Siam, is by throwing three or four strong nets across a river, at proper distances from each other; so that if the animal breaks through the first, it may be caught by one of the rest. When it is first taken, it employs the tail, which is the grand instrument of strength, with great force; but after many unsuccessful struggles, the animal's strength is at last exhausted. Then the natives approach their prisoner in boats, and pierce him with their weapons in the most tender parts, till he is weakened by the loss of blood. When he has done stirring, they begin by tying up his mouth, and with the same cord they fasten his head to his tail, which last they bend back like a bow. However, they are not yet perfectly secure from his fury; but, for their greater safety, they tie his fore-feet, as well as those behind, to the top of his back. These precautions are not useless: for if they were to omit them, the crocodile would soon recover strength enough to do a great deal of mischief.

The crocodile, thus brought into subjection, or bred up young, is used to divert and entertain the great men of the East. It is often managed like a horse; a curb is put into his mouth, and the rider directs it as he thinks proper. Though awkwardly formed, it does not fail to proceed with some degree of swiftness; and it is thought to move as fast as some of the most unwieldly of our own animals, the hog or the cow.[1] Some, indeed, assert, that no animal could escape it, but for its difficulty in turning; but to this resource we could wish none would trust who are so unhappy as to find themselves in danger.

Along the rivers of Africa this animal is sometimes taken in the same manner as the shark. Several Europeans go together in a large boat, and throw out a piece of beef upon a hook and strong fortified line, which the crocodile seizing and swallowing, is drawn along, floundering and struggling until its strength is quite exhausted, when it is pierced in the belly, which is its tenderest part; and thus, after numberless wounds, is drawn ashore. In this part of the world also, as well as at Siam, the crocodile makes an object of savage pomp near the palaces of their monarchs. Philips informs us that at Sabi, on the slave coast, there are two pools of water, near the royal palace, where crocodiles are bred, as we breed carp in our ponds in Europe.

Hitherto I have been describing the crocodile as it is found in unpeopled countries, and

[1] Waterton, in his interesting Wanderings in South America, gives an account of a ride he had on a crocodile's back. He and his Indians having secured a monster of the Essequibo, by a baited hook fastened to a long rope, "they pulled the cayman," as he describes (p. 231), "within two yards of me. I saw he was in a state of fear and perturbation; I instantly dropped the mast, sprung up, and *jumped on his back*, turning half round as I vaulted, so that I gained my seat with my face in a right position. I immediately seized his fore legs and by main force twisted on his back; thus they served me for a bridle."—This was at first laughed at as incredible, but it is now known to be a feat of not unusual occurrence.

undisturbed by frequent encounters with mankind.[1] In this state it is fierce and cruel, attacking every object that seems endued with motion: but in Egypt, and other countries long peopled, where the inhabitants are civilized, and the rivers frequented, this animal is solitary and fearful. So far from coming to attack a man, it sinks at his approach with the utmost precipitation; and, as if sensible of superior power, ever declines the engagement. We have seen more than one instance in animated nature of the contempt which at first the lower orders of the creation have for man, till they have experienced his powers of destruction. The lion and the tiger among beasts, the whale among fishes, the albatross and the penguin among birds, meet the first encounters of man without dread or apprehension; but they soon learn to acknowledge his superiority, and take refuge from his power in the deepest fastnesses of nature. This may account for the different characters which have been given us of the crocodile and the alligator, by travellers at different times; some describing them as harmless and fearful, as ever avoiding the sight of a man, and preying only upon fishes: others ranking them among the destroyers of nature; describing them as furnished with strength, and impelled by malignity, to do mischief; representing them as the greatest enemies of mankind, and particularly desirous of human prey. The truth is, the animal has been justly described by both; being such as it is found in places differently peopled or differently civilized. Wherever the crocodile has reigned long unmolested, it is there fierce, bold, and dangerous; wherever it has been harassed by mankind, its retreats invaded, and its numbers destroyed, it is there timorous and inoffensive.

In some places, therefore, this animal, instead of being formidable, is not only inoffensive, but is cherished and admired. In the river San Domingo, the crocodiles are the most inoffensive animals in nature; the children play with them, and ride about on their backs; they even beat them sometimes, without receiving the smallest injury. It is true the inhabitants are very careful of this gentle breed, and consider them as harmless domestics.

It is probable that the smell of musk, which all these animals exhale, may render them agreeable to the savages of that part of Africa. They are often known to take the part of this animal which contains the musk, and wear it as a perfume about their persons. Travellers are not agreed in what part of the body these musk-bags are contained; some say in the ears; some, in the parts of generation; but the most probable opinion is, that this musky substance is amassed in glands under the legs and arms. From whatsoever part of the body this odour proceeds, it is very strong and powerful, tincturing the flesh of the whole body with its taste and smell. The crocodile's flesh is at best very bad tough eating; but unless the musk bags be separated it is insupportable. The negroes themselves cannot well digest the flesh; but then, a crocodile's egg is to them the most delicate morsel in the world. Even savages exhibit their epicures as well as we; and one of true taste will spare neither pains nor danger to furnish himself with his favourite repast. For this reason, he often watches the places where the female comes to lay her eggs, and upon her retiring seizes the booty.

All crocodiles breed near fresh waters; and though they are sometimes found in the sea, yet that may be considered rather as a place of excursion than abode. They produce their young by eggs, as was said above; and for this purpose the female, when she comes to lay, chooses a place by the side of a river, or some fresh-water lake, to deposit her brood in. She always pitches upon an extensive sandy shore, where she may dig a hole without danger of detection from the ground being fresh turned up. The shore must also be gentle and shelving to the water, for the greater convenience of the animal's going and returning; and a convenient place must be found near the edge of the stream, that the young may have a shorter way to go. When all these requisites are adjusted, the animal is seen cautiously stealing upon shore to deposit her burden. The presence of a man, a beast, or even a bird, is sufficient to deter her at that time; and if she perceives any creature looking on, she infallibly returns. If, however, nothing appears, she then goes to work, scratching up the sand with her fore-paws, and making a hole pretty deep in the shore. There she deposits from eighty to a hundred eggs, of the size of a tennis-ball, and of the same figure, covered with a tough white skin like parchment. She takes above an hour to perform this task; and then covering up the place so artfully that it can scarcely be perceived, she goes back to return again the next day. Upon her return, with the same precaution as before, she lays about the same number of eggs; and the day following also a like number. Thus having deposited her whole quantity, and having covered them close up in the sand, they are soon vivified by the

[1] It is a very remarkable observation, that the crocodile, when it appears out of the water, is almost surrounded by various large birds, particularly the pelican. It has been asked, whether there exists the same sympathy between these birds (especially the pelican) and the crocodile, which the heron has for buffaloes, oxen, and cows?

heat of the sun ; and at the end of thirty days, the young ones begin to break open the shell. At this time the female is instinctively taught that her young ones want relief; and she goes upon land to scratch away the sand, and set them free. Her brood quickly avail themselves of their liberty : a part run unguided to the water; another part ascend the back of the female, and are carried thither in greater safety. But the moment they arrive at the water, all natural connection is at an end ; when the female has introduced her young to their natural element, not only she, but the male, become among the number of their most formidable enemies, and devour as many of them as they can. The whole brood scatters into different parts of the bottom ; by far the greatest number is destroyed, and the rest find safety in their agility or minuteness.

But it is not the crocodile alone that is thus found to thin their numbers; the eggs of this animal are not only a delicious feast to the savage, but are eagerly sought after by every beast and bird of prey. The ichneumon was erected into a deity among the ancients for its success in destroying the eggs of these monsters : at present that species of the vulture called the Gallinazo is their most prevailing enemy. All along the banks of great rivers, for thousands of miles, the crocodile is seen to propagate in numbers that would soon overrun the earth, but for the vulture, that seems appointed by Providence to abridge its fecundity. These birds are ever found in greatest numbers where the crocodile is most numerous: and hiding themselves within the thick branches of the trees that shade the banks of the river, they watch the female in silence, and permit her to lay all her eggs without interruption. Then when she has retired, they encourage each other with cries to the spoil; and flocking all together upon the hidden treasure, tear up the eggs, and devour them in a much quicker time than they were deposited. Nor are they less diligent in attending the female while she is carrying her young to the water; for if any one of them happens to drop by the way, it is sure to receive no mercy.

Such is the extraordinary account given us by late travellers of the propagation of this animal ; an account adopted by Linnæus and the most learned naturalists of the age.[1] Yet, if one might argue from the general analogy of nature, the crocodile's devouring her own young when she gets to the water seems doubtful. This may be a story raised from the general idea of this animal's rapacious cruelty ; when, in fact, the crocodile only seems more cruel than other animals, because it has more power to do mischief. It is probable that it is not more divested of parental tenderness than other creatures, and I am the more led to think so from the peculiar formation of one of the crocodile kind. This is called the Open-Bellied Crocodile, and is furnished with a false belly like the oppossum, where the young creep out and in, as their dangers or necessities require. The crocodile thus furnished at least cannot be said to be an enemy to her own young, since she thus gives them more than parental protection. It is probable, also, that this open-bellied crocodile is viviparous, and fosters her young that are prematurely excluded in this second womb, until they come to proper maturity.[2]

How long the crocodile lives we are not certainly informed : if we may believe Aristotle, it lives the age of a man : but the ancients so much amused themselves in inventing fables concerning this animal, that even truth from them is suspicious. What we know for certain from the ancients is, that among the various animals that were produced to fight in the amphitheatre at Rome, the combat of the crocodile was not wanting.[3] Marcus Scarus produced them living in his unrivalled exhibitions; and the Romans considered him as their best citizen, because he furnished them with the most expensive entertainments. But entertainment at that corrupt time was their only occupation.

CHAP. III.

OF THE SALAMANDER.[4]

The ancients have described a lizard that is bred from heat, that lives in the flames, and

[1] Ulloa.

[2] None of the lizard tribe have any thing like an abdominal pouch for the safety of their young.

[3] Plin. lib. viii. c. 26.

[4] *The Salamander.*—The Salamander belongs to that order of reptiles called *Batrachians*, from their resemblance, to a certain extent, to the frog tribes. The *Batrachia* include all the reptiles with naked bodies, without the hard covering of the tortoises, or scales like serpents. The whole of this order are without nails on the toes, and they all undergo various changes or metamorphoses; the different changes in the organization of the salamanders nearly resemble those which occur in the case of the frogs and toads.

The body of the salamander is covered with pores, from which, when alarmed, or suffering from pain, an acrid watery humour exudes, which is at times able so far to quench the fury of the flames as to give the poor creature time to escape, and in this simple fact consists the whole of the mysterious power that has been attributed to it.

The salamanders are divided into two sections, the aquatic, that rarely leave the water, (our common eft is an example,) and the terrestrial, who only remain in that element during their tadpole state. The aquatic

feeds upon fire as its proper nourishment. As they saw every other element, the air, the earth, and water, inhabited, fancy was set to work to find or make an inhabitant in fire; and thus to people every part of nature. It will be needless to say that there is no such animal existing; and that of all others, the modern salamander has the smallest affinity to such an abode.

Whether the animal that now goes by the name of Salamander be the same with that described by Pliny, it is a doubt with me; but this is not a place for the discussion. It is sufficient to observe, that the modern salamander is an animal of the lizard kind, and under this name is comprehended a large tribe that all go by the same name. There have been not less than seven sorts of this animal described by Seba; and to have some idea of the peculiarity of their figure, if we suppose the tail of a lizard applied to the body of a frog, we shall not be far from precision. The common lizard is long, small, and taper; the salamander, like the frog, has its eyes towards the back of the head; like the frog, its snout is round, and not pointed, and its belly thick and swollen. The claws of its toes are short and feeble; its skin rough; and the tongue, unlike that of the smallest of the lizard kind, in which it is long and forked, is short, and adhering to the under jaw.

But it is not in figure that this animal chiefly differs from the rest of the lizard tribe; for it seems to differ in nature and conformation. In nature it is unlike, being a heavy torpid animal; whereas the lizard tribe are active, restless, and ever in motion; in conformation it is unlike, as the salamander is produced alive from the body of its parent, and is completely formed the moment of its exclusion. It differs from them also in its general reputation of being venomous: however, no trials that have been hitherto made seem to confirm the truth of the report.

Not only this, but many others of the lizard tribe, are said to have venom; but it were to be wished that mankind, for their own happiness, would examine into the foundation of this reproach. By that means many of them, that are now shunned and detested, might be found inoffensive; their figure, instead of either exciting horror or disgust, would then only tend to animate the general scene of nature; and speculation might examine their manners in confidence and security. Certain it is, that all the lizard kind, with which we are acquainted in this country, are perfectly harmless; and it is equally true that, for a long time, till our prejudices were removed, we considered not only the Newt, but the Snake and the Blind-worm, as fraught with the most destructive poison. At present we have got over these prejudices; and, it is probable, that if other nations made the same efforts for information, it would be found, that the malignity of most, if not all, of the lizard tribe, was only in the imagination.

With respect to the salamander, the whole tribe, from the Moron to the Gekko, are said to be venomous to the last degree; yet, when experiments have been tried, no arts, no provocations, could excite these animals to the rage of biting. They seem timid and inoffensive, only living upon worms and insects; quite destitute of fangs, like the viper, their teeth are so very small that they are hardly able to inflict a wound. But as the teeth are thus incapable of offending, the people of the countries where they are found have recourse to a venomous slaver, which, they suppose, issues from the animal's mouth; they also tell us of a venom issuing from the claws: even Linnæus seems to acknowledge the fact; but thinks it a probable supposition that this venom may proceed from their urine.

Of all animals, the Gekko is the most notorious for its powers of mischief; yet we are

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salamanders have a tail flattened sideways, so as to assist them in swimming.

The experiments of Spallanzani, on their astonishing power of reproducing a limb, have rendered them famous. The same limb can be reproduced several times in succession, after it has been cut off, and that with all its bones, muscles, &c. Another faculty, not less singular, is that of remaining a long time encompassed with ice without perishing.

The salamanders were erroneously placed by Linnæus among the lizards, but they have been most properly transferred to the order to which they now belong, and to which they bear a much greater affinity, especially from their transformations. The following cut represents the *Gigantic Salamander*.



Although it is called gigantic, in reference to the size of most of the genus, it does not exceed eighteen inches in length. Some few years back, however, a salamander was discovered in Japan, to which the name gigantic might be applied with much greater propriety. A living specimen was taken, and conveyed to the museum at Leyden five years since; it was then about twelve inches long, but it has since then grown to the length of two feet and a half, although confined in a wooden vessel containing water. It is of a very dark olive-green colour, and covered with tubercles, nearly resembling in form the species represented in the engraving. It feeds sparingly on small living fish which are placed in its prison; its appetite, however, only recurs at long intervals, and its destined prey seem perfectly unconscious of the presence of an enemy, and when alarmed, take refuge under the very jaws of the reptile.

told by those who load it with that calumny, that it is very friendly to man, and though supplied with the most deadly virulence, is yet never known to bite. It would be absurd in us, without experience, to pronounce upon the noxious or inoffensive qualities of animals, yet it is probable, from an inspection of the teeth of lizards, and from their inoffensive qualities in Europe, that the gekko has been unjustly accused; and that its serpent-like figure has involved it in one common reproach with serpents.

The salamander best known in Europe, is from eight to eleven inches long, usually black, spotted with yellow; and, when taken in the hand, feeling cold to a great degree.—There are several kinds. Our Black Water-Newt is reckoned among the number. The idle report of its being inconsumable in fire, has caused many of these poor animals to be burnt; but we cannot say as philosophical martyrs, since scarcely any philosopher could think it necessary to make the experiment. When thrown into the fire, the animal is seen to burst with the heat of its situation, and to eject its fluids. We are gravely told, in the Philosophical Transactions, that this is a method the animal takes to extinguish the flames!

When examined internally, the salamander exhibits little difference from other animals of the lizard kind. It is furnished with lungs that sometimes serve for the offices of breathing; with a heart that has its communications open, so that the animal cannot easily be drowned. The ovary in the female is double the size of what it is in others of this tribe; and the male is furnished with four testiculi instead of two. But what deserves particular notice is the manner of this animal's bringing forth its young alive.[1] "The salamander," says my author, "begins to show itself in spring, and chiefly during heavy rains. When the warm weather returns, it disappears; and never leaves its hole, during either great heats or severe colds, both which it equally fears. When taken in the hand, it appears like a lump of ice; it consequently loves the shade, and is found at the feet of old trees surrounded with brushwood at the bottom. It is fond of running along new ploughed grounds: probably to seek for worms, which are its ordinary food. One of these," continues my author, "I took alive some years ago in a ditch that had been lately made. I laid it at the foot of the stairs upon coming home, and there it disgorged from the throat a *worm* three inches long, that lived for an hour after, though wounded as I suppose by the teeth of the animal. I afterwards cut up another of these lizards, and saw not less than fifty young ones, resembling the parent, come from its womb, all alive, and actively running about the room." It were to be wished the author had used another word besides that of *worm*; as we now are in doubt whether he means a real worm, or a young animal of the lizard species: had he been more explicit, and had it appeared that it was a real young lizard, which I take to be his meaning, we might here see a wonder of Nature brought to the proof, which many have asserted, and many have thought proper to deny; I mean the refuge which the young of the shark, the lizard, and the viper kinds, are said to take, by running down the throat of the parent, and there finding a temporary security. The fact, indeed, seems a little extraordinary; and yet it is so frequently attested by some, and even believed by others, whose authority is respectable, among the number of whom we find Mr Pennant, that the argument of strangeness must give way to the weight of authority.

However this be, there is no doubt of the animal's being viviparous, and producing above fifty at a time. They come from the parent in full perfection, and quickly leave her to shift for themselves. These animals, in the lower ranks of nature, want scarcely any help when excluded; they soon complete the little circle of their education; and in a day or two are capable of practising all the arts of subsistence and evasion practised by their kind.

They are all amphibious, or at least are found capable of subsisting in either element, when placed there: if those taken from land are put into water, they continue there in seeming health: and, on the contrary, those taken from the water will live upon land. In water, however, they exhibit a greater variety in their appearance; and what is equally wonderful with the rest of their history, during the whole spring and summer, this water-lizard changes its skin every fourth or fifth day; and during the winter every fifteen days. This operation they perform by means of the mouth and the claws: and it seems a work of no small difficulty and pain. The cast skins are frequently seen floating on the surface of the water: they are sometimes seen also with a part of their old skin still sticking to one of their limbs, which they have not been able to get rid of; and thus, like a man with a boot half drawn, in some measure crippled in their own spoils. This also often corrupts, and the leg drops off; but the animal does not seem to feel the want of it, for the loss of a limb to all the lizard kind is but a trifling calamity. They can live several hours even after the loss of

[1] Acta Hafniensia, ann. 1676. Observ. 11. Memoires de l'Academie Royale des Sciences, tom. iii. part 3. p. 80.

their head: and for some time under dissection, all the parts of this animal seem to retain life: but the tail is the part that longest retains its motion. Salt seems to be much more efficacious in destroying these animals than the knife; for upon being sprinkled with it, the whole body emits a viscous liquor, and the lizard dies in three minutes, in great agonies.

The whole of the lizard kind are also tenacious of life in another respect, and the salamander among the number. They sustain the want of food in a surprising manner. One of them, brought from the Indies, lived nine months, without any other food than what it received from licking a piece of earth on which it was brought over;[1] another was kept by Seba in an empty vial for six months, without any nourishment; and Rhedi talks of a large one, brought from Africa, that lived for eight months, without taking any nourishment whatever. Indeed, as many of this kind, both salamanders and lizards, are torpid, or nearly so, during the winter, the loss of their appetite for so long a time is the less surprising.

CHAP. IV.

OF THE CAMELEON, THE IGUANA, AND LIZARDS OF DIFFERENT KINDS.

It were to be wished that animals could be so classed, that by the very mentioning their rank, we should receive some insight into their history. This I have endeavoured in most instances; but in the present chapter all method is totally unserviceable. Here distribution gives no general ideas: for some of the animals to be here mentioned produce by eggs; some by spawn; and some are viviparous. The peculiar manner of propagating in each, is very indistinctly known. The Iguana and the Cameleon, we know bring forth eggs; some others also produce in the same manner; but of the rest, which naturalists make amount to above fifty, we have but very indistinct information.

In the former divisions of this tribe, we had to observe upon animals, formidable from their size, or disgusting from their frog-like head and appearance; in the present division, all the animals are either beautiful to the eye, or grateful to the appetite. The lizards, properly so called, are beautifully painted and mottled; their frolicsome agility is amusing to those who are familiar with their appearance; and the great affection which some of them show to man, should, in some measure, be repaid with kindness. Others, such as the Iguana, though not possessed of beauty, are very serviceable, furnishing one of the most luxurious feasts the tropical climates can boast of. Those treated of before were objects of curiosity, because they were apparently objects of danger; most of these here mentioned have either use or beauty to engage us.

Directly descending from the crocodile, we find the Cordyle, the Tockay, and the Tejuguacu, all growing less in order, as I have named them. These fill up the chasm to be found between the crocodile and the African Iguana.

The Iguana, which deserves our notice, is about five feet long, and the body about as thick as one's thigh; the skin is covered with small scales, like those of a serpent; and the back is furnished with a row of prickles, that stand up, like the teeth of a saw: the eyes seem to be but half opened, except when the animal is angry, and then they appear large and sparkling: both the jaws are full of very sharp teeth, and the bite is dangerous, though not venomous, for it never lets loose till it is killed. The male has a skin hanging under his throat, which reaches down to his breast; and, when displeased, he puffs it up like a bladder; he is one-third larger and stronger than the female; though the strength of either avails them little towards their defence. The males are ash-coloured, and the females are green.[2]

[1] Phil. Trans. ann. 1661. N. 21. art. 7.

[2] The *Common American Iguana* is from four to five feet long. It is very common in all the warm parts of America, where it remains in the woods, at the environs of rivers, and sources of spring-water. It passes most part of its time on trees, sometimes going to the water, and living on fruits, grain, and leaves. Without being either venomous or dangerous, its bite is exceedingly painful; and when it is angry, the goitre which it has under its neck becomes distended and expanded. This reptile has great tenacity and endurance of life, and will resist the blows of a stick or cudgel very well. Accordingly, it is usually hunted with the bow or the gun.

The females are smaller than the males, but their colours are much more brilliant. They lay eggs in the sand, about as large as those of pigeons, but a little longer, and of equal thickness at both ends. The shell of these eggs is white, even, and soft. They are entirely filled by the yolk, and can hardly be said to have any albumen. They never harden by fire, but only become a little pasty. But their flavour is very agreeable, and they are constantly eaten in Surinam and Guiana. A single female will lay about six dozen.

The flesh of the iguana is considered as delicious, and is in great estimation throughout all the warm parts of America. It is white and delicate. Many persons, however, consider it as unwholesome, especially for those who are infected with syphilis, some symptoms of which, such as pains in the bones, &c. it is supposed to aggravate or cause the return of. At Paramaraibo, it is sold extremely dear, and highly thought of by epicures. Pison, and many others of the old travellers in America, have spoken in high terms of the virtues of the bezoar of the iguana, a kind of stone, found, say they, in the stomach or cranium of this reptile. But, at the present day,

The flesh of these may be considered as the greatest delicacy of Africa and America; and the sportsmen of those climates go out to hunt the iguana, as we do in pursuit of the pheasant or the hare. In the beginning of the season, when the great floods of the tropical climates are passed away, and vegetation starts into universal verdure, the sportsmen are seen, with a noose and a stick, wandering along the sides of the rivers to take the iguana. The animal, though apparently formed for combat, is the most harmless creature of all the forest: it lives among the trees, or sports in the water, without ever offering to offend; there, having fed upon the flowers of the mahot, and the leaves of the mapou, that grow along the banks of the stream, it goes to repose upon the branches of the trees that hang over the water. Upon the land the animal is swift of foot; but when once in possession of a tree, it seems conscious of the security of its situation, and never offers to stir. There the sportsman easily finds it, and as easily fastens his noose round its neck: if the head be placed in such a manner that the noose cannot readily be fastened, by hitting the animal a blow on the nose with the stick, it lifts the head, and offers it in some measure to the noose. In this manner, and also by the tail, the iguana is dragged from the trees, and killed by repeated blows on the head.

The Cameleon is a very different animal; and as the iguana satisfies the appetites of the epicure, this is rather the feast of the philosopher. Like the crocodile, this little animal proceeds from an egg; and it also nearly resembles that formidable creature in form; but it differs widely in its size and its appetites; being not above eleven inches long, and delighting to sit upon trees, being afraid of serpents, from which it is enabled to escape on the ground.

The head of a large cameleon is almost two inches long; and from thence to the beginning of the tail, four and a half: the tail is five inches long, and the feet two and a half: the thickness of the body is different at different times; for sometimes, from the back to the belly, it is two inches, and sometimes but one; for it can blow itself up, and contract itself at pleasure. This swelling and contraction is not only of the back and belly but of the legs and tail.

These different tumors do not proceed from a dilatation of the breast in breathing, which rises and falls by turns; but are very irregular, and seem adopted merely from caprice. The cameleon is often seen, as it were, blown up for two hours together; and then it continues growing less and less insensibly; for the dilatation is always more quick and visible than the contraction. In this last state the animal appears extremely lean; the spine of the back seems sharp, and all the ribs may be counted; likewise the tendons of the legs and arms may be seen very distinctly.

This method of puffing itself up, is similar to that in pigeons, whose crops are sometimes

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this substance is fallen into the most absolute disrepute among all medical practitioners.

The *slate-coloured Iguana* is but three feet in length. It inhabits the same places as the former species, and may be merely a variety of it, in age or sex. Seba derives it from the island of Formosa.

The *horned Iguana* of St Domingo is about four feet long. It is frequently found in the hills of St Domingo, between Artibonite and Gonaives. It lives on fruits, insects, and small birds, which it seizes with marvellous agility, and during the day it couches on trees and rocks to watch for its prey. During the night, and the entire season of the great heats, it retires into the hollows of rocks, or into the holes of old trees, and it passes about five or six months of the year there in a state of lethargy. This reptile is considered by the negroes as a delicious meat, and is accordingly sought after by them with great avidity. According to the report of the colonists, its flesh resembles in flavour that of the roebuck, and the maroon dogs make great slaughter among these reptiles. The colours of this iguana are not precisely known.

Some authors place here the *iguana fasciata*. Its colour is deep blue, with transverse bands of a clearer tint. The goitre is moderate, and not denticulated. There is no large scale at the angle of the jaw. This iguana belongs to the island of Java. It may probably be the reptile which Bontius has named *cameleon*. It is also probable, that to this species must be referred the very large iguanas which are found at Batavia, and which are sometimes as thick as a man's thigh. In his voyage with Captain Cook, Sir Joseph Banks killed one of these, which was five feet in length.

Under the name of *Basilisk* is at present designated a genus of reptiles, of this saurian order, which exhibits many affinities with the iguanas and monitors. No animal, perhaps, has been the subject of so great a number of prejudices as the one now under consideration. The most ancient authors have spoken of the basilisk, as of a serpent which had the power of striking its victim dead by a single glance. Others have pretended that it could not exercise this faculty, unless it first perceived the object of its vengeance before it was itself perceived by it. It was also most absurdly imagined to proceed from the eggs of old cocks. Aldrovandus, and several other writers have given figures of it. They have represented it with eight feet, a crown on the head, and a hooked and recurved beak. Pliny assures us that the serpent named basilisk has a voice so terrible, that it strikes terror into all other species, that it thus chases them from the spot which it inhabits, and of which it retains the sole and undisputed dominion. The name, indeed, of basilisk, Βασιλικος, signifies royal. The fantastic forms, and fabulous properties thus attributed to an animal, which most probably never had any existence, rendered this name too celebrated for naturalists not to endeavour to apply it to another species, which accordingly they did. Seba has figured a species of lizard, whose head is surmounted with projecting lines, and the back furnished with a broad vertical crest, which extends as far over the tail, and which that author believed to be intended for the purposes of flight. He has designated it under the name of basilisk, or dragon of America, a flying amphibious animal. This is the animal which has subsequently been described in all works of natural history under the name of basilisk.—*Supplement to the English edition of Cuvier.*

greatly distended with air. The cameleon has a power of driving the air it breathes over every part of the body; however, it only gets between the skin and the muscles; for the muscles themselves are never swollen. The skin is very cold to the touch; and though the animal seems so lean, there is no feeling the beating of the heart. The surface of the skin is unequal, and has a grain not unlike shagreen, but very soft, because each eminence is as smooth as if it were polished. Some of these little protuberances are as large as a pin's head, on the arms, legs, belly, and tail; but on the shoulders and head they are of an oval figure, and a little larger; those under the throat are ranged in the form of a chaplet, from the lower lip to the breast. The colour of all these eminences, when the cameleon is at rest in a shady place, is of a bluish gray, and the space between is of a pale red and yellow.

But when the animal is removed into the sun, then comes the wonderful part of its history. At first it appears to suffer no change of colour, its grayish spots still continuing the same: but the whole surface soon seems to imbibe the rays of light; and the simple colouring of the body changes into a variety of beautiful hues. Wherever the light comes upon the body, it is of a tawny brown; but that part of the skin on which the sun does not shine, changes into several brighter colours, pale yellow, or vivid crimson; which forms spots of the size of half one's finger: some of these descend from the spine half way down the back; and others appear on the sides, arms, and tail. When the sun has done shining, the original gray colour returns by degrees, and covers all the body. Sometimes the animal becomes all over spotted with brown spots, of a greenish cast. When it is wrapt up in a white linen cloth for two or three minutes, the natural colour becomes much lighter; but not quite white, as some authors have pretended: however, from hence it must be concluded that the cameleon assumes the colour of the objects which it approaches; this is entirely an error, and probably has taken its rise from the continual changes it appears to undergo.[1]

[1] The skin of the cameleon is composed of a sort of small, scaly grains, and, under ordinary circumstances, is of a greenish-gray colour. The general form of the body reminds one of the lizard, but the trunk is compressed, and the back highly ridged or cutting. The occiput, or hinder part of the head, is elevated pyramidically; the eyes are large, projecting far outwards, yet almost entirely covered over by the skin, except immediately opposite the pupil. What is still more singular, the eyes are capable of moving independently of each other, taking different directions at the same moment; there is no visible external ear; the tongue is fleshy, round, and capable of being greatly lengthened; the teeth are three-pronged. Each of the feet has five toes, but these are separated into two portions (one containing two and the other three toes) by the skin, which covers them entirely to the nails. The tail is long and round, and capable of grasping twigs or branches, to sustain the animal. The lungs of the chameleon are so large, that when inflated to the utmost, the whole body becomes almost transparent. With the different degrees of inflation, the surface undergoes changes of colour, owing to the variations produced in the distribution of the blood, and not, as has been fabled, by the animal assuming the colour of the body upon which it happens to be placed.

It is scarcely possible to witness any thing more curious or beautiful than the transitions from hue to hue, exhibited by the cameleon, when aroused to motion. The cameleons are all exceedingly slow, dull and almost torpid. The only part which they move with celerity is their long tongue. This organ is clothed, at its extremity, with a viscid, gluey mucus, and is darted out for the purpose of capturing insects, upon which the animal subsists. As they feed but seldom, and are frequently seen inhaling the air, to inflate their bodies as above-mentioned, ancient observers concluded that they fed altogether on air; but closer attention to their habits has shown that they require a diet rather more substantial. Three or four species are well known, and are natives of Africa and the Molucca islands. They pass their lives altogether upon trees, feeding upon small insects, for which their construction shows them to be perfectly adapted.

Le Bruyn, in his Voyage to the Levant, has given us a very ample description of the cameleon. During his stay at Smyrna, he bought several of this kind; and to try how

The *Variegated Lizard*.—This, which is by far the largest in this division of the genus, sometimes exceeds the guana in size. The head is covered, as in the green lizard, with large scales or plates; the body with small and somewhat square scales, which are so disposed as to mark the sides into numerous tapering annuli or striæ, passing from the back perpendicularly downwards, and from the sides perpendicularly upwards, the narrow end of each row alternating with the broader end of the opposite one; and in the younger animals a kind of plated appearance, or continued lateral wrinkle appears to pass along each side of the animal; the tail, which is very long, is surrounded by extremely numerous rings of small square scales, and tapers to a slender point. The colour in the larger animals is highly beautiful, consisting of an elegant, and in general somewhat minute variegation of brown, or blackish and purple spots, on a pale bluish-white, and in some parts yellowish ground. The whole form of the animal is rather thick or plump, in comparison with many other lizards: the tongue is broad, flat, long, forked at the tip, and curiously serrated on each side; the head shaped like that of the Arneivo, to which this species is nearly allied. It is a native of South America.

The *Green Lizard*.—The common green lizard is a native of both Europe and India. This species is also extremely nimble; it basks on the sides of dry banks, or under old trees in the hot weather, but, on being observed, immediately retreats to its hole. The food of this, as well as all other British lizards, is insects; and they themselves are devoured by birds of prey. They are all perfectly harmless, yet their form strikes almost every beholder with disgust, and has occasioned great obscurity in their history. Mr Pennant mentions a lizard killed in Worcestershire, in the year 1714, which was two feet six inches long, and four inches in girth; the fore-legs were placed eight inches from the head, the hind-legs five inches behind those; the legs were two inches long; and the feet divided into four toes,

long they could live, kept four of them in a cage, permitting them at times to run about the house. The fresh sea-breeze seemed to give them most spirits and vivacity; they opened their mouths to take it in; he never perceived that they eat any thing, except now and then a fly, which they took half an hour to swallow: he observed their colour often to change, three or four times successively, without being able to find out any cause for such alterations; their common colour he found to be gray, or rather a pale mouse colour; but its most frequent changes were into a beautiful green, spotted with yellow; sometimes the animal was marked all over with dark brown; and this often changes into a lighter brown: some colours, however, it never assumed; and contrary to what was said above, he found red to be among the number.

Though our traveller took the utmost care, he was unable to preserve any of them alive above five months; and many of them died in four. When the cameleon changes place, and attempts to descend from an eminence, it moves with the utmost precaution, advancing one leg very deliberately before the other, still securing itself by holding whatever it can grasp by the tail. It seldom opens its mouth, except for fresh air; and when that is supplied, discovers its satisfaction by its motions, and the frequent changes of its colour. The tongue is sometimes darted out after its prey, which is flies; and this is as long as the whole body. The eyes are remarkably little, though they stand out of the head; they have



each furnished with a sharp claw. Another of the same kind was afterwards killed in that county: but whether these large lizards were natives of other countries, and imported into England, or whether they were of British growth, is uncertain, though the former is more probable, as in this country they scarcely ever exceed six inches. This species has a pretty long verticulated tail, with sharp scales, and a scaly collar.

The green lizard of Carolina is denominated from its colour. It is very slender; the tail nearly double the length of the body; and the whole length above five inches. It inhabits Carolina, where it is domestic, familiar, and harmless. It sports on the tables and windows, and amuses with its agility in catching flies. Cold affects its colours: in that uncertain climate, when there is a quick transition in the same day from hot to cold, it changes instantly from the most brilliant green to a dull brown. They are a prey to cats and ravenous birds. They appear chiefly in summer; and at the approach of cold weather they retire to their winter recesses, and lie torpid in the holes and crevices of hollow trees. It frequently happens, that a few warm sunshiny days so invigorate them, that they will come out of their holes and appear abroad; when on a sudden the weather changes to cold, they become so feeble as to be unable to return to their retreats, and consequently expire.

The *Nimble Lizard.*—This elegant little creature, which is known in almost every part of the temperate regions of Europe, seems to be the most gentle and inoffensive, and at the same time, the most useful of all the lizard tribe. It is fond of basking in the sun; but, unable to bear extensive heat, in the hottest weather it seeks for shelter. In spring, during fine weather, it may sometimes be seen luxuriously extended on a sloping green bank, or on a wall exposed to the sun. In these situations it enjoys the full effects of the reviving warmth, expressing its delight by gently agitating its slender tail; and its lively and brilliant eyes are animated with pleasure.—Should any of the minute animals, on which it feeds, appear, it springs upon them with the quickness of thought; and if any danger occurs, the creature itself seeks a more secure retreat with equal rapidity. On the least noise it turns suddenly round, drops down, and seems, for a moment, perfectly stupified by its fall; or else it suddenly shoots away among the bushes or thick grass. Its wonderful rapidity of motion is chiefly to be observed in warm countries, for in the temperate regions its evolutions are much more languid. This gentle and peaceful animal excites no sensations of terror; and, when taken into the hand, makes not the smallest attempt either to bite or offend. In some countries, children use it as a play-thing; and, in consequence of its natural gentleness of disposition, it becomes in a great measure tame and familiar.

The *Sand Lizard.*—This species is found on sandy



heaths in some parts of England. Its colour is in general brown, and its length seven inches. It is more sluggish than the common lizard, and will attempt to bite any one who handles it.

The *Frilled Lizard*, of which the following cut re-



presents the figure, is a curious species found in Australia. Little is known of its habits.

a single eye-lid, like a cap with a hole in the middle, through which the sight of the eye appears, which is of a shining brown; and round it there is a little circle of a gold colour: but the most extraordinary part of their conformation is, that the animal often moves one eye, when the other is entirely at rest: nay sometimes one eye will seem to look directly forward, while the other looks backward; and one will look upward, while the other regards the earth.

To this class of lizards, we may refer the Dragon, a most terrible animal, but most probably not of Nature's formation. Of this death-dealing creature all people have read; and the most barbarous countries, to this day, paint it to the imagination in all its terrors, and fear to meet it in every forest. It is not enough that nature has furnished those countries with poisons of various malignity; with serpents forty feet long; with elephants, lions, and tigers; to make their situation really dangerous, the capricious imagination is set at work to call up new terrors; and scarce a savage is found that does not talk of winged serpents of immoderate length, flying away with the camel or the rhinoceros, or destroying mankind by a single glare. Happily, however, such ravagers are no where found to exist at present; and the whole race of dragons is dwindled down to the Flying Lizard, a little harmless creature, that only preys upon insects, and even seems to embellish the forest with its beauty.

The Flying Lizard of Java perches upon fruit-trees, and feeds upon flies, ants, butterflies, and other small insects. It is a very harmless creature, and does no mischief in any respect. Gentil, in his voyage round the World, affirms, that he has seen these lizards at the island of Java, in the East Indies. He observed they flew very swiftly from tree to tree; and having killed one, he could not but admire the skin, which was painted with several beautiful colours: it was a foot in length, and had four paws, like the common lizards: but its head was flat, and had a small hole in the middle; the wings were very thin, and resembled those of a flying fish. About the neck were a sort of wattles, not unlike those of cocks, which gave it no disagreeable appearance. He intended to have preserved it, in order to bring it into Europe; but it was corrupted by the heat, before the close of the day; however, they have since been brought into England, and are now common enough in the cabinets of the curious.

The last animal of the lizard kind that I shall mention, is the Chalcidian Lizard of Aldrovandus, very improperly called the Seps by modern historians, This animal seems to make the shade that separates the lizard from the serpent race. It has four legs, like the lizard; but so short, as to be utterly unserviceable in walking: it has a long slender body, like the serpent; and is said to have the serpent's malignity also. The fore legs are very near the head; the hind legs are placed far backward; but before and behind they seem rather useless incumbrances, than instruments serving to assist the animal in its motions, or in providing for its subsistence. These animals are found above three feet long, and thick in proportion, with a large head and pointed snout. The whole body is covered with scales; and the belly is white mixed with blue. It has four crooked teeth, as also a pointed tail, which, however, can inflict no wound. Whether the teeth be similar to the viper's fangs, we are not told; though Volateranus says, they are covered with a membrane; by which I am apt to think he means a venom-bag, which is found at the root of teeth of all serpents that are poisonous. It is viviparous; fifteen young ones having been taken alive out of its belly. Upon the whole, it appears to bear a strong affinity to the viper; and, like that animal, its bite may be dangerous.

OF FROGS, LIZARDS, AND SERPENTS.

BOOK III.

OF SERPENTS, ETC.

CHAP. I.

OF SERPENTS IN GENERAL.[1]

We now come to a tribe, that not only their deformity, their venom, their ready malignity, but also our prejudices, and our very religion, have taught us to detest. The serpent has, from the beginning, been the enemy of man; and it has hitherto continued to terrify and annoy him, notwithstanding all the arts that have been practised to destroy it. Formidable in itself, it deters the invader from the pursuit; and, from its figure, capable of finding shelter in a little space, it is not easily discovered by those who would venture to try the encounter. Thus possessed at once of potent arms and inaccessible or secure retreats, it baffles all the arts of man, though never so earnestly bent upon its destruction.

For this reason, there is scarce a country in the world that does not still give birth to this poisonous brood, that seem formed to quell human pride, and repress the boasts of security. Mankind have driven the lion, the tiger, and the wolf from their vicinity; but the snake

[1] The serpent tribes are distinguished from all other animals by a peculiar character, in which their figure, motion, and habits, so repulsive and disgusting, form a striking contrast to the beautiful and variegated colours with which their skin is studded, adding, if possible, to their subtile and venomous appearance; while their crawling motion strikingly exemplifies the *decree of the Creator*, made after the temptation and fall of man:—"Because thou hast done this, cursed art thou above all cattle, and every bird of the field; upon thy belly shalt thou go, and dust thou shalt eat all the days of thy life."

The tribes are very numerous, and have been divided by Lacepede into eight genera, each of which are subdivided, and contain many species. The genera comprise the Boas, containing 11 species; the Rattle-snake, 6 species; the Vipers, 196 species; the Snakes, 24 species; the Amphisbœna, 5 species; Langrata, 1; Cœcilia, 2; and Acrochord, 1.

Although destitute of feet and wings, few animals are so active as serpents, or can transport themselves from place to place with equal agility. Whether to seize its prey, or escape from danger, the serpent moves with the velocity of an arrow, and surpasses several species of birds in the ease and rapidity with which it gains the summits of the highest trees, twisting and untwisting its flexible body around their trunks and branches with such celerity, that the quickest eye can scarcely follow its rapid motion. Their size greatly varies; some are but a few inches long, while others are forty, or even fifty feet in length. All are covered with scales, or scaly tubercles. Their brain case is weak and shallow; and hence serpents are easily killed by a blow on the head. The formation and conjunction of the vertebræ are well adapted for mobility.

All parts of their body have great force, agility, and elasticity. They are most abundant in warm and temperate regions; but increase in size and numbers, in proportion to the heat and moisture, and to the freedom of their range. They have less blood than quadrupeds, a lower animal heat, and less interior activity of system. They are more animated in times of tempest and hurricane, when the electricity of the atmosphere is in the greatest perturbation. Their sense of hearing is dull, but their vision acute. Their sense of taste is probably of considerable delicacy, as the tongue is very slender, and divided into two joints, which admit of its being readily applied to sapid bodies. Their sense of touch is probably obscure. They give many indications of high instinct and sensibility, and have the faculty of existing a long period without food.

They have no voice, but a hiss, which is uttered softer or stronger according to the exciting cause. It is exerted exclusively in the declaration of their fiercer passions —the milder sensibilities are not accompanied by any vocal annunciation.

Serpents have great strength from the peculiar construction of their body. They are very tenacious of life. They have been, from all antiquity, and in most countries, celebrated for their great cunning and sagacity; which is chiefly displayed in their mode of evading their enemies, or of obtaining their prey. Some serpents are eminently noted for their brilliant colours, of which several display fine iridescent changes. It is a curious distinction of these animals, which has lately been made by M. de la Borde, of Cayenne, that nearly all the species of serpents of which the young are hatched within the mother, and which are therefore born alive, are venomous.

and the viper still defy their power, and frequently punish their insolence.

Their numbers, however, are thinned by human assiduity; and it is possible some of the kinds are wholly destroyed. In none of the countries of Europe are they sufficiently numerous to be truly terrible; the philosopher can meditate in the fields without danger; and the lover seek the grove without fearing any wounds but those of metaphor. The various malignity that has been ascribed to European serpents of old is now utterly unknown; there are not above three or four kinds that are dangerous, and their poison operates in all in the same manner. A burning pain in the part, easily removable by timely applications, is the worst effect that we can experience from the bite of the most venomous serpents of Europe. The drowsy death, the starting of the blood from every pore, the insatiable and burning thirst, the melting down the solid mass of the whole form into one heap of putrefaction, these are horrors with which we are entirely unacquainted.

But though we have thus reduced these dangers, having been incapable of wholly removing them, in other parts of the world they still rage with all their ancient malignity. Nature seems to have placed them as centinels, to deter mankind from spreading too widely, and from seeking new abodes, till they have thoroughly cultivated those at home. In the warm countries that lie within the tropics, as well as in the cold regions of the north, where the inhabitants are few, the serpents propagate in equal proportion. But of all countries, those regions have them in the greatest abundance where the fields are unpeopled and fertile, and where the climate supplies warmth and humidity. All along the swampy banks of the river Niger or Oroonoko, where the sun is hot, the forests thick, and the men but few, the serpents cling among the branches of the trees in infinite numbers, and carry on an unceasing war against all other animals in their vicinity. Travellers have assured us, that they have often seen large snakes twining round the trunk of a tall tree, encompassing it like a wreath, and thus rising and descending at pleasure. In these countries, therefore, the serpent is too formidable to become an object of curiosity, for it excites much more violent sensations.

We are not, therefore, to reject, as wholly fabulous, the accounts left us by the ancients of the terrible devastations committed by a single serpent. It is probable, in early times, when the arts were little known, and mankind were but thinly scattered over the earth, that serpents, continuing undisturbed possessors of the forests, grew to an amazing magnitude: and every other tribe of animals fell before them. It then might have happened, that serpents reigned the tyrants of a district for centuries together. To animals of this kind, grown by time and rapacity to a hundred or a hundred and fifty feet in length, the lion, the tiger, and even the elephant itself, were but feeble opponents. The dreadful monster spread desolation round him; every creature that had life was devoured, or fled to a distance. That horrible *fœtor*, which even the commonest and the most harmless snakes are still found to diffuse, might, in these larger ones, become too powerful for any living being to withstand; and while they preyed without distinction, they might thus also have poisoned the atmosphere around them. In this manner, having for ages lived in the hidden and unpeopled forest, and finding as their appetites were more powerful, the quantity of their prey decreasing, it is possible they might venture boldly from their retreats, into the more cultivated parts of the country, and carry consternation among mankind, as they had before desolation among the lower ranks of nature. We have many histories of antiquity, presenting us such a picture; and exhibiting a whole nation sinking under the ravages of a single serpent. At that time, man had not learned the art of uniting the efforts of many, to effect one great purpose. Opposing multitudes only added new victims to the general calamity, and increased mutual embarrassment and terror. The animal was, therefore, to be singly opposed by him who had the greatest strength, the best armour, and the most undaunted courage. In such an encounter hundreds must have fallen; till one, more lucky than the rest, by a fortunate blow, or by taking the monster in its torpid interval, and surcharged with spoil, might kill, and thus rid his country of the destroyer. Such was the original occupation of heroes: and those who first obtained that name, from their destroying the ravagers of the earth, gained it much more deservedly than their successors, who acquired their reputation only for their skill in destroying each other. But as we descend into more enlightened antiquity, we find these animals less formidable, as being attacked in a more successful manner. We are told, that while Regulus led his army along the banks of the river Bagrada, in Africa, an enormous serpent disputed his passage over. We are assured by Pliny, who says, that he himself saw the skin, that it was a hundred and twenty feet long, and that he had destroyed many of the army. At last, however, the battering engines were brought out against it; and these assailing it at a distance, it was soon destroyed. Its spoils were carried to Rome, and the general was decreed an ovation for his success. There are, perhaps, few facts better ascertained in history

than this: an ovation was a remarkable honour; and was given only for some signal exploit that did not deserve a triumph: no historian would offer to invent that part of the story at least, without being subject to the most shameful detection. The skin was kept for several years after in the capitol; and Pliny says, he saw it there: now, though Pliny was a credulous writer, he was by no means a *false* one; and whatever he says he has seen, we may very safely rely on. At present, indeed, such ravages from serpents are scarcely seen in any part of the world; not but that in Africa and America some of them are powerful enough to brave the assaults of men to this day.

But, happily for us, we are placed at such a distance as to take a view of this tribe without fearing for our safety; we can survey their impotent malignity with the same delight with which the poet describes the terrors of a dead monster.

> Nequeant expleri corda tuendo
> Terribiles oculos villosaque setis pectora.

To us their slender form, their undulating motion, their vivid colouring, their horrid stench, their forky tongue, and their envenomed fangs, are totally harmless; and in this country their uses even serve to counterbalance the mischief they sometimes occasion.

If we take a survey of serpents in general, they have marks by which they are distinguished from all the rest of animated nature. They have the length and the suppleness of the eel, but want fins to swim with: they have the scaly covering and pointed tail of the lizard, but they want legs to walk with; they have the crawling motion of the worm, but, unlike that animal, they have lungs to breathe with: like all the reptile kind, they are resentful when offended; and nature has supplied them with terrible arms to revenge every injury.

Though they are possessed of very different degrees of malignity, yet they are all formidable to man, and have a strong similitude of form to each other; and it will be proper to mark the general character before we descend to particulars. With respect to their conformation, all serpents have a very wide mouth, in proportion to the size of the head; and, what is very extraordinary, they can gape and swallow the head of another animal which is three times as big as their own. I have seen a toad taken out of the belly of a snake, at lord Spencer's, near London, the body of which was thrice the diameter of the animal that swallowed it. However, it is no way surprising that the skin of the snake should stretch to receive so large a morsel: the wonder seems how the jaws could take it in. To explain this, it must be observed that the jaws of this animal do not open as ours, in the manner of a pair of hinges, where bones are applied to bones, and play upon one another; on the contrary, the serpent's jaws are held together at the roots by a stretching muscular skin; by which means they open as widely as the animal chooses to stretch them, and admit of a prey much thicker than the snake's own body. The throat, like stretching leather, dilates to admit the morsel; the stomach receives it in part; and the rest remains in the gullet, till putrefaction and the juices of the serpent's body unite to dissolve it.

As to the teeth, I will talk more of them when I come to treat of the viper's poison; it will be sufficient here to observe, that some serpents have fangs, or canine teeth, and others are without them. The teeth in all are crooked and hollow; and, by a peculiar contrivance, are capable of being erected or depressed at pleasure.

The eyes of all serpents are small, if compared to the length of the body; and though differently coloured in different kinds, yet the appearance of all is malign and heavy; and, from their known qualities, they strike the imagination with the idea of a creature meditating mischief. In some, the upper eye-lid is wanting, and the serpent winks only with that below; in others, the animal has a nictitating membrane or skin, resembling that which is found in birds, which keeps the eye clean, and preserves the sight. The substance of the eye in all is hard and horny; the crystalline humour occupying a great part of the globe.

The holes for hearing are very visible in all: but there is no conduits for smelling; though it is probable that some of them enjoy that sense in tolerable perfection.

The tongue in all these animals is long and forky. It is composed of two long fleshy substances, which terminate in sharp points, and are very pliable. At the root it is connected very strongly to the neck by two tendons, that give it a variety of play. Some of the viper kind have tongues a fifth part of the length of their bodies; they are continually darting them out, but they are entirely harmless, and only terrify those who are ignorant of the real situation of their poison.

If from the jaws we go on to the gullet, we shall find it very wide for the animal's size, and capable of being distended to a great degree; at the bottom of this lies the stomach, which is not so capacious, and receives only a part of the prey, while the rest continues in the gullet for digestion. When the substance in the stomach is dissolved into chyle, it passes into the intestines, and from thence goes to nourishment, or to be excluded by the vent.

Like most other animals, serpents are furnished with lungs, which, I suppose, are serviceable in breathing, though we cannot perceive the manner in which this operation is performed; for though serpents are often seen, apparently, to draw in their breath, yet we cannot find the smallest signs of their ever respiring it again. Their lungs, however, are long and large, and doubtless are necessary to promote their languid circulation. The heart is formed as in the tortoise, the frog, and the lizard kinds, so as to work without the assistance of the lungs. It is single, the greatest part of the blood flowing from the great vein to the great artery by the shortest course. By this contrivance of nature we easily gather two consequences—that snakes are amphibious, being equally capable of living on land and in the water; and that also they are torpid in winter, like the bat, the lizard, and other animals formed in the same manner.

The vent in these animals serves for the emission of the urine and the fæces, and for the purposes of generation. The instrument of generation in the male is double, being forked like the tongue; the ovaries in the female are double also; and the aperture is very large, in order to receive the double instrument of the male. They copulate in their retreats; and it is said by the ancients, that, in this situation, they appear like one serpent with two heads: but how far this remark is founded in truth, I do not find any of the moderns that can resolve me.

As the body of this animal is long, slender, and capable of bending in every direction, the number of joints in the back-bone are numerous beyond what one would imagine. In the generality of quadrupeds, they amount to not above thirty or forty; in the serpent kind they amount to a hundred and forty-five from the head to the vent, and twenty-five more from that to the tail.[1] The number of these joints must give the back-bone a surprising degree of pliancy; but this is still increased by the manner in which each of these joints are locked into the other. In man and quadrupeds, the flat surfaces of the bones are laid one against the other, and bound tight by sinews: but in serpents, the bones play one within the other, like ball and socket, so that they have full motion upon each other in every direction.[2] Thus, if a man were to form a machine composed of so many joints as are found in the back of a serpent, he would find it no easy matter to give it such strength and pliancy at the same time. The chain of a watch is but a bungling piece of workmanship in comparison.

Though the number of joints in the back-bone is great, yet that of the ribs is still greater; for, from the head to the vent there are two ribs to every joint, which makes their number two hundred and ninety in all. These ribs are furnished with muscles, four in number; which being inserted into the head, run along to the end of the tail, and give the animal great strength and agility in all its motions.

The skin also contributes to its motions, being composed of a number of scales, united to each other by a transparent membrane, which grows harder as it grows older, until the animal changes, which is generally done twice a year. This cover then bursts near the head, and the serpent creeps from it, by an undulatory motion, in a new skin, much more vivid than the former. If the old slough be then viewed, every scale will be distinctly seen, like a piece of net-work, and will be found greatest where the part of the body they covered was largest.

There is much geometrical neatness in the disposal of the serpent's scales for assisting the animal's sinuous motion. As the edges of the foremost scales lie over the ends of their following scales, so those edges, when the scales are erected, which the animal has a power of doing in a small degree, catch in the ground, like the nails in the wheel of a chariot, and so promote and facilitate the animal's progressive motion. The erecting these scales is by means of a multitude of distinct muscles, with which each is supplied, and one end of which is tacked each to the middle of the foregoing.

In some of the serpent kind there is the exactest symmetry in these scales; in others, they are disposed more irregularly. In some, there are larger scales on the belly, and often answering to the number of ribs; in others, however, the animal is without them. Upon this slight difference Linnæus has founded his distinctions of the various classes of the serpent tribe. Human curiosity, however, and even human interest, seem to plead for a very different method of distribution. It is not the number of scales on a formidable animal's belly, nor their magnitude or variety, that any way excite our concern. The first question that every man will naturally ask, when he hears of a snake, is, whether it be large? the second, whether it be venomous? In other words, the strongest lines in the animal's history are those that first excite our attention; and these it is every historian's business to display.

When we come to compare serpents with each other, the first great distinction appears in their size; no other tribe of animals differing so widely in this particular. What, for instance, can be so remotely separated as the Great Liboya of Surinam, that grows to thirty-six feet long; and the Little Serpent, at the

[1] Vide Charat. Anatom. [2] Derham, p. 396.

Cape of Good Hope, and the north of the river Senegal, that is not above three inches, and covers whole sandy deserts with its multitudes! This tribe of animals, like that of fishes, seems to have no bounds put to their growth: their bones are, in a great measure, cartilaginous, and they are, consequently, capable of great extension: the older, therefore, a serpent becomes, the larger it grows; and as they seem to live to a great age, they arrive at an enormous size.

Leguat assures us, that he saw one in Java that was fifty feet long. Carli mentions their growing to above forty feet; and we have now the skin of one in the Museum, that measures thirty-two. Mr Wentwort, who had large concerns in the Berbices, in America, assures me, that in that country, they grow to an enormous length. He one day sent out a soldier, with an Indian, to kill wild fowl for the table; and they accordingly went some miles from the fort; in pursuing their game, the Indian, who generally marched before, beginning to tire, went to rest himself upon the fallen trunk of a tree, as he supposed it to be; but when he was just going to sit down, the enormous monster began to move, and the poor savage perceiving that he had approached a Liboya, the greatest of all the serpent kind, dropped down in an agony. The soldier, who perceived, at some distance, what had happened, levelled at the serpent's head, and, by a lucky aim, shot it dead: however, he continued his fire until he was assured that the animal was killed; and then going up to rescue his companion, who was fallen motionless by its side, he, to his astonishment, found him dead likewise, being killed by the fright. Upon his return to the fort, and telling what had happened, Mr Wentworth ordered the animal to be brought up, when it was measured, and found to be thirty-six feet long. He had the skin stuffed, and then sent to Europe, as a present to the Prince of Orange, in whose cabinet it is now to be seen at the Hague; but the skin has shrunk, by drying, two or three feet.

In the East Indies they grow also to an enormous size; particularly in the island of Java, where, we are assured, that one of them will destroy and devour a buffalo. In a letter, printed in the German Ephemerides, we have an account of a combat between an enormous serpent and a buffalo, by a person who assures us that he was himself a spectator. The serpent had, for some time, been waiting near the brink of a pool, in expectation of its prey; when a buffalo was the first that offered. Having darted upon the affrighted animal, it instantly began to wrap it round with its voluminous twistings; and, at every twist, the bones of the buffalo were heard to crack almost as loud as the report of a cannon. It was in vain that the poor animal struggled and bellowed; its enormous enemy entwined it too closely to get free; till, at length, all its bones being mashed to pieces, like those of a malefactor on the wheel, and the whole body reduced to one uniform mass, the serpent untwined its folds to swallow its prey at leisure. To prepare for this, and in order to make the body slip down the throat more glibly, it was seen to lick the whole body over, and thus cover it with its mucus. It then began to swallow it at that end that offered least resistance; while its length of body was dilated to receive its prey, and thus took in at once a morsel that was three times its own thickness. We are assured by travellers, that these animals are often found with the body of a stag in their gullet, while the horns, which they are unable to swallow, keep sticking out at their mouths.

But it is happy for mankind that the rapacity of these frightful creatures is often their punishment; for whenever any of the serpent kind have gorged themselves in this manner, whenever their body is seen particularly distended with food, they then become torpid, and may be approached and destroyed with safety. Patient of hunger to a surprising degree, whenever they seize and swallow their prey, they seem, like surfeited gluttons, unwieldly, stupid, helpless, and sleepy: they, at that time seek some retreat, where they may lurk for several days together, and digest their meal in safety: the smallest effort, at that time, is capable of destroying them; they can scarcely make any resistance; and they are equally unqualified for flight or opposition: that is the happy opportunity of attacking them with success; at that time the naked Indian himself does not fear to assail them. But it is otherwise when this sleepy interval of digestion is over: they then issue, with famished appetites, from their retreats, and with accumulated terrors, while every animal of the forest flies before them.

Carli describes the Long Serpent of Congo making its track through the tall grass, like mowers in a summer's day. He could not, without terror, behold whole lines of grass lying levelled under the sweep of its tail. In this manner it moved forward with great rapidity, until it found a proper situation frequented by its prey: there it continued to lurk, in patient expectation, and would have remained for weeks together, had it not been disturbed by the natives.

Other creatures have a choice in their provision; but the serpent indiscriminately preys upon all; the buffalo, the tiger, and the gazelle. One would think that the porcupine's quills might be sufficient to protect it; but whatever has life serves to appease the hun-

ger of these devouring creatures: porcupines, with all their quills, have frequently been found in their stomachs, when killed and opened; nay, they most frequently are seen to devour each other.

A life of savage hostility in the forest offers the imagination one of the most tremendous pictures in nature. In those burning countries, where the sun dries up every brook for hundreds of miles round; when what had the appearance of a great river in the rainy season, becomes, in summer, one dreary bed of sand —in those countries, I say, a lake that is never dry or a brook that is perennial, is considered by every animal as the greatest convenience of nature. As to food, the luxuriant landscape supplies that in sufficient abundance: it is the want of water that all animals endeavour to remove; and inwardly parched by the heat of the climate, traverse whole deserts to find out a spring. When they have discovered this, no dangers can deter them from attempting to slake their thirst. Thus the neighbourhood of a rivulet, in the heart of the tropical continents, is generally the place where all the hostile tribes of nature draw up for the engagement. On the banks of this little envied spot, thousands of animals of various kinds are seen venturing to quench their thirst, or preparing to seize their prey. The elephants are perceived, in a long line, marching from the darker parts of the forest; the buffaloes are there, depending upon numbers for security; the gazelles, relying solely upon their swiftness; the lion and tiger waiting a proper opportunity to seize; but chiefly the larger serpents are upon guard there, and defend the accesses of the lake. Not an hour passes without some dreadful combat; but the serpent, defended by its scales, and naturally capable of sustaining a multitude of wounds, is, of all others, the most formidable. It is the most wakeful also; for the whole tribe sleep with their eyes open, and are, consequently, for ever upon the watch: so that, till their rapacity is satisfied, few other animals will venture to approach their station.

But though these animals are, of all others, the most voracious, and though the morsel which they swallow without chewing is greater than what any other creature, either by land or water, the whale itself not excepted, can devour, yet no animals upon earth bear abstinence so long as they. A single meal, with many of the snake kind, seems to be the adventure of a season; it is an occurrence for which they have been for weeks, nay, sometimes for months, in patient expectation of. When they have seized their prey, their industry, for several weeks, is entirely discontinued; the fortunate capture of an hour often satisfies them for the remaining period of their annual activity. As their blood is colder than that of most other terrestrial animals, and as it circulates but slowly through their bodies, so their powers of digestion are but feeble. Their prey continues for a long time, partly in the stomach, partly in the gullet, and a part is often seen hanging out of the mouth. In this manner, it digests by degrees; and in proportion as the part below is dissolved, the part above is taken in. It is not therefore, till this tedious operation is entirely performed that the serpent renews its appetite and its activity. But should any accident prevent it from issuing once more from its cell, it still can continue to bear famine for weeks, months, nay, for years together. Vipers are often kept in boxes for six or eight months without any food whatever; and there are little serpents sometimes sent over to Europe from Grand Cairo, the name of which I have not been able to learn, that live, for several years, in glasses, and never eat at all, nor even stain the glass with their excrements. Thus the serpent tribe unite, in themselves, two very opposite qualities: wonderful abstinence, and yet incredible rapacity.

If, leaving the consideration of their appetites, we come to compare serpents, as to their voices, some are found silent, some have a peculiar cry; but hissing is the sound which they most commonly sent forth, either as a call to their kind, or as a threat to their enemies. In the countries where they abound, they are generally silent in the middle of the day, when they are obliged to retire from the heat of the climate; but as the cool of the evening approaches, they are then heard issuing from their cells with continued hissings; and such is the variety of their notes, that some have assured me they very much resemble the music of an English grove. This some will hardly credit—at any rate, such notes, however pleasing, can give but very little delight, when we call to mind the malignity of the minstrel. If considered, indeed, as they answer the animal's own occasions, they will be found well adapted to its nature, and fully answering the purposes of terrifying such as would venture to offend it.

With respect to motion, some serpents, particularly those of the viper kind, move slowly; while others, such as the Ammodytes, dart with amazing swiftness. The motion in all is similar; but the strength of body in some gives a very different appearance. The viper, that is but a slow feeble-bodied animal, makes way in a heavy undulating manner; advancing its head, then drawing up its tail behind, and bending the body into a bow; then, from the spot where the head and tail were united, advancing the head forward as before. This, which is the motion of all

serpents, is very different from that of the earth-worm, or the naked snail. The serpent, as was said above, has a back-bone with numerous joints, and this bone the animal has a power of bending in every direction, but without being able to shorten or lengthen it at pleasure. The earth-worm, on the other hand, has no back-bone; but its body is composed of rings, which, like a barber's puff, it can lengthen or shorten as it finds necessary. The earth-worm, therefore, in order to move forward, lengthens the body; then, by the fore part clings to the ground, where it has reached, and then contracts and brings up its rear: then, when the body is thus shortened, the fore part is lengthened again for another progression; and so on. The serpent, instead of shortening the body, bends it into an arch; and this is the principal difference between serpentine and vermicular progression.

I have instanced this motion in the viper, as most easily discerned; but there are many serpents that dart with such amazing swiftness, that they appear rather to leap than crawl. It is most probable, however, that no serpent can dart upon even ground farther than its own length at one effort. Our fears, indeed, may increase the force of their speed, which is sometimes found so fatal. We are told by some, that they will dart to a very great distance; but this my inquiries have never been able to ascertain. The manner of progression in the swiftest serpent we know, which is the jacalus, is by instantly coiling itself upon its tail, and darting from thence to its full extent; then carrying the tail as quick as lightning to the head, coiling and darting again; and by this means proceeding with extreme rapidity, without ever quitting the ground. Indeed, if we consider the length and the weakness of the back-bone in all these animals; if we regard the make of their vertebræ, in which we shall find the junctures all formed to give play, and none to give power; we cannot be of opinion that they have a faculty of springing from the ground, as they entirely want a *fulcrum*, if I may so express it, from whence to take their spring; the whole body being composed of unsupported muscles and joints that are yielding. It must be confessed, that they dart down from trees upon their prey; but their weight alone is sufficient for that purpose without much effort of their own.

Though all serpents are amphibious, some are much fonder of the water than others; and, though destitute of fins or gills, remain at the bottom, or swim along the surface with great ease. From their internal structure, just sketched above, we see how well adapted they are for either element; and how capable their blood is of circulating at the bottom, as freely as in the frog or the tortoise. They can, however, endure to live in fresh-water only; for salt is an effectual bane to the whole tribe. The greatest serpents are most usually found in fresh-water, either choosing it as their favourite element, or finding their prey in such places in the greatest abundance. But that all will live and swim in liquids appears from the experiment of Rhedi; who put a serpent into a large glass vessel of wine, where it lived swimming about six hours; though, when it was by force, immersed and kept under that liquid, it lived only one hour and a half. He put another in common water, where it lived three days; but when it was kept under water, it lived only about twelve hours.[1] Their motion there, however, is perfectly the reverse of what it is upon land; for, in order to support themselves upon an element lighter than their bodies, they are obliged to increase their surface in a very artificial manner. On earth their windings are perpendicular to the surface; in water they are parallel to it; in other words, if I should wave my hand up and down, it will give an idea of the animal's progress on land; if I should wave it to the right and left, it will give some idea of its progress on the water.

Some serpents have a most horrible fœtor attending them, which is alone capable of intimidating the brave. This proceeds from two glands near the vent, like those in the weasel or polecat; and, like those animals, in proportion as they are excited by rage, or by fear, the scent grows stronger. It would seem, however, that such serpents as are most venomous, are least offensive in this particular; since the rattlesnake and the viper have no smell whatever: nay, we are told that at Calicut and Cranganon, in the East Indies, there are some very noxious serpents who are so far from being disagreeable, that their excrements are sought after, and kept as the most pleasing perfume. The Esculapian Serpent is also of this number.

Some serpents bring forth their young alive, as the viper; some bring forth eggs, which are hatched by the heat of their situation: as the common black snake, and the majority of the serpent tribe. When a reader, ignorant of anatomy, is told, that some of those animals produce their young alive, and that some produce eggs only, he is apt to suppose a very great difference in the internal conformation, which makes such a variety in the manner of bringing forth. But this is not the case: these animals are internally alike, in whatever manner they produce their young; and the variety in their bringing forth is rather a slight, than a real discrimination. The only difference is, that the viper hatches her eggs, and brings them to maturity within her body;

[1] Rhedi, Exper. p. 170.

the snake is more premature in her productions, and sends her eggs into the light some time before the young ones are capable of leaving the shell. Thus, if either are opened, the eggs will be found in the womb, covered with their membranous shell, and adhering to each other like large beads on a string. In the eggs of both, young ones will be found, though at different stages of maturity: those of the viper will crawl and bite the moment the shell that incloses them is broke open; those of the snake are not yet arrived at their perfect form.

Father Labat took a serpent of the viper kind, that was nine feet long, and ordered it to be opened in his presence. He then saw the manner in which the eggs of these animals lie in the womb. In this creature there were six eggs, each of the size of a goose egg, but longer, more pointed, and covered with a membranous skin, by which also they were united to each other. Each of these eggs contained from thirteen to fifteen young ones, about six inches long, and as thick as a goose-quill. Though the female from whence they were taken was spotted, the young seemed to have a variety of colours very different from the parent; and this led the traveller to suppose that the colour was no characteristic mark among serpents. These little mischievous animals were no sooner let loose from the shell than they crept about, and put themselves into a threatening posture, coiling themselves up, and biting the stick with which he was destroying them. In this manner he killed seventy-four young ones; those that were contained in one of the eggs escaped at the place where the female was killed, by the bursting of the egg, and their getting among the bushes.

The last distinction that I shall mention, but the most material among serpents, is, that some are venomous, and some inoffensive. If we consider the poison of serpents as it relates to man, there is no doubt but that it is a scourge and an affliction. The various calamities that the poison of serpents is capable of producing, are not only inflicted by the animal itself, but by men, more mischievous than even serpents, who prepare their venom to destroy each other. With this the savages poison their arms, and also prepare their revengeful potions. The ancients were known to preserve it for the purposes of suicide; and even among semi-barbarous countries at this day, the venom of snakes is used as a philtre.

But, though the poison be justly terrible to us, it has been given to very good purposes for the animal's own proper support and defence. Without this, serpents, of all other animals, would be the most exposed and defenceless; without feet for escaping a pursuit; without teeth capable of inflicting a dangerous wound, or without strength for resistance; incapable, from their size, of finding security in very small retreats, like the earth-worm, and disgusting all from their deformity, nothing was left for them but a speedy extirpation. But furnished as they are with powerful poison, every rank of animals approach them with dread, and never seize them but at an advantage. Nor is this all the advantage they derive from it. The malignity of a few serves for the protection of all. Though not above a tenth of their number are actually venomous, yet the similitude they all bear to each other excites a general terror of the whole tribe; and the uncertainty of their enemies in which the poison chiefly resides, makes even the most harmless formidable.—Thus providence seems to have acted with double precaution; it has given some of them poison, for the general defence of a tribe naturally feeble; but it has thinned the numbers of those which are venomous, lest they should become too powerful for the rest of animated nature.

From these noxious qualities in the serpent kind, it is no wonder that not only man, but the beasts and birds, carry on an unceasing war against them. The ichneumon of the Indians, and the peccary of America, destroy them in great numbers. These animals have the art of seizing them near the head; and it is said that they can skin them with great dexterity. The vulture and the eagle also prey upon them in great abundance; and often sousing down from the clouds, drop upon a long serpent, which they snatch up struggling and writhing in the air. Dogs are also bred up to oppose them. Father Feuille tells us, that being in the woods of Martinico, he was attacked by a large serpent, which he could not easily avoid, when his dog immediately came to his relief, and seized the assailant with great courage. The serpent entwined him, and pressed him so violently, that the blood came out of his mouth, and yet the dog never ceased till he had torn it to pieces. The dog was not sensible of his wounds during the fight; but soon after his head swelled prodigiously, and he lay on the ground as dead. But his master having found hard by a banana-tree, he applied its juice, mixed with treacle, to the wounds, which recovered the dog, and quickly healed his sores.

But it is in man that these venomous creatures find the most dangerous enemy. The Psylli of old were famous for charming and destroying serpents. Some moderns pretend to the same art. Casaubon says, that he knew a man who could at any time summon a hundred serpents together, and draw them into the fire. Upon a certain occasion, when one of them, bigger than the rest, would not be brought in, he only repeated his charm, and it came forward like the rest, to submit

to the flames. Philostratus describes particularly how the Indians charm serpents. "They take a scarlet robe, embroidered with golden letters, and spread it before a serpent's hole. The golden letters have a fascinating power; and, by looking steadfastly, the serpent's eyes are overcome and laid asleep." These, and many other feats have been often practised upon these animals by artful men, who had first prepared the serpents for their exercise, and then exhibited them as adventitiously assembled at their call. In India there is nothing so common as dancing serpents, which are carried about in a broad flat vessel, somewhat resembling a sieve. These erect and put themselves in motion at the word of command. When their keeper sings a slow tune, they seem by their heads to keep time; when he sings a quicker measure, they appear to move more brisk and lively. All animals have a certain degree of docility; and we find that serpents themselves can be brought to move and approach at the voice of their master. From this trick, successfully practised before the ignorant, it is most probable has arisen all the boasted pretensions which some have made to charming of serpents; an art to which the native Americans pretend at this very day. One of Linnæus's pupils, we are told, purchased the secret from an Indian, and then discovered it to his master; but, like all secrets of the kind, it is probable this ended in a few unmeaning words of no efficacy.[1]

Though the generality of mankind regard this formidable race with horror, yet there have been some nations, and there are some at this day, that consider them with veneration and regard. The adoration paid by the ancient Egyptians to a serpent is well known: many of the nations at present along the western coast of Africa retain the same unaccountable veneration. Upon the Gold and Slave coasts, a stranger, upon entering the cottages of the natives, is often surprised to see the roof swarming with serpents, that cling there without molesting, and unmolested by the natives. But his surprise will increase upon going farther southward to the kingdom of Widah, when he finds that a serpent is the god of the country. This animal, which travellers describe as a huge overgrown creature, has its habitation, its temple, and its priests. These impress the vulgar with an opinion of its virtues; and numbers are daily seen to offer not only their goods, their provisions, and their prayers, at the shrine of

[1] The *incantation of serpents* is one of the most curious and interesting facts in natural history. This wonderful art, which disarms the fury, and soothes the wrath of the deadliest snake, and renders it obedient to the charmer's voice, is not an invention of modern times; for we discover manifest traces of it in the remotest antiquity. It is asserted, that Orpheus, who probably flourished soon after letters were introduced into Greece, knew how to still the hissing of the approaching snake, and to extinguish the poison of the creeping serpent. The Argonauts are said to have subdued by the power of song, the terrible dragon that guarded the golden fleece; and Ovid ascribes the same effect to the soporific influence of certain herbs, and magic sentences. It was the custom of others to fascinate the serpent, by touching it with the hand. Of this method Virgil takes notice, in the seventh book of the Ænead. But it seems to have been the general persuasion of the ancients, that the principal power of the charmer lay in the sweetness of the music. Pliny says, accordingly, that serpents were drawn from their lurking-places by the power of music. Seneca held the same opinion.

The wonderful effect which music produces on the serpent tribes is confirmed by the testimony of several respectable moderns. Adders swell at the sound of a flute, raising themselves up on the one half of their body, turning themselves round, beating proper time and following the instrument. Their head, naturally round and long like an eel, becomes broad and flat like a fan. The tame serpents, many of which the Orientals keep in their houses, are known to leave their holes in hot weather, at the sound of a musical instrument, and to run upon the performer. Dr Shaw had an opportunity of seeing a number of serpents keep exact time with the dervishes in their circulating dances, running over their heads and arms, turning when they turned, and stopping when they stopped.

The rattle snake acknowledges the power of music as much as any of his family; of which the following instance is a decisive proof. When Chateaubriand was in Canada, a snake of this species entered their encampment; a young Canadian, one of the party who could play on the flute, to divert his associates, advanced against the serpent with his new species of weapon. "On the approach of his enemy, the haughty reptile curled himself into a spiral line, flattened his head, inflated his cheeks, contracted his lips, displayed his envenomed fangs, and his bloody throat; his double tongue glowed like two flames of fire; his eyes were burning coals; his body, swoln with rage, rose and fell like the bellows of a forge; his dilated skin assumed a dull and scaly appearance, and his tail, which sounded the denunciation of death, vibrated with so great rapidity, as to resemble a light vapour. The Canadian now began to play upon his flute; the serpent started with surprise, and drew back his head. In proportion as he was struck with the magic effect, his eyes lost their fierceness, the oscillations of his tail became slower, and the sound which it emitted became weaker, and gradually died away. Less perpendicular upon their spiral line, the rings of the fascinated serpent were by degrees expanded, and sunk one after another upon the ground in concentric circles. The shades of azure green, white, and gold, recovered their brilliancy on his quivering skin, and slightly turning his head, he remained motionless in the attitude of attention and pleasure. At this moment the Canadian advanced a few steps, producing with his flute sweet and simple notes. The reptile inclining his variegated neck, opened a passage with his head through the high grass, and began to creep after the musician, stopping when he stopped, and beginning to follow him again as soon as he moved froward." In this manner he was led out of the camp, attended by a great number of spectators, both savages and Europeans, who could scarcely believe their eyes, when they beheld this wonderful effect of harmony. The assembly unanimously decreed, that the serpent which had so highly entertained them, should be permitted to escape.—*Natural History of the Bible.*

their hideous deity, but also their wives and daughters.—These the priests readily accept of, and after some days of penance, return them to their suppliants, much benefited by the serpent's supposed embraces. Such a complicated picture of ignorance and imposture gives no very favourable impressions of our fellow-creatures; but we may say, in defence of human nature, that the most frightful of reptiles is worshipped by the most uncultivated and barbarous of mankind.

From this general picture of the serpent tribe, one great distinction obviously presents itself; namely, into those that are venomous, and those that are wholly destitute of poison. To the first belong the viper, the rattle-snake, the cobra di capello, and all their affinities; to the other, the common black snake, the liboya, the boiguacu, the amphisbæna, and various others, that, though destitute of venom, do not cease to be formidable. I will, therefore, give their history separately, beginning with the venomous class, as they have the strongest claims to our notice and attention.

CHAP. II.

OF VENOMOUS SERPENTS IN GENERAL.

The poison of serpents has been for ages one of the greatest objects of human consideration. To us, who seldom feel the vengeful wound, it is merely a subject of curiosity; but to those placed in the midst of the serpent tribe, who are every day exposed to some new disaster, it becomes a matter of the most serious importance. To remedy the bite of a serpent is considered, among our physicians, as one of the slightest operations in medicine: but among the physicians of the East, the antidotes for this calamity make up the bulk of their dispensaries. In our colder climates, the venom does not appear with that instantaneous operation which it exhibits in the warmer regions; for either its powers are less exquisite, or our fluids are not carried round in such rapid circulation.

In all countries, however, the poison of the serpent is sufficiently formidable to deserve notice, and to excite our attention to its nature and effects. It will, therefore, in the first place, be proper to describe its seat in the animal, as also the instrument by which the wound is made, and the poison injected. In all this venomous class of reptiles, whether the viper, the rattle-snake, or the cobra di capello, there are two large teeth or fangs that issue from the upper jaw, and that hang out beyond the lower. The rest of the snake tribe are destitute of these; and it is most probable that wherever these fangs are wanting, the animal is harmless; on the contrary, wherever they are found it is to be avoided as the most pestilent enemy. These are the instruments that seem to place the true distinction between animals of the serpent kind; the wounds which these fangs inflict produce the most dangerous symptoms; the wounds inflicted by the teeth only are attended with nothing more than the ordinary consequences attending the bite of any other animal. Our first great attention, therefore, upon seeing a serpent, should be directed to the teeth. If it has the fang teeth, it is to be placed among the venomous class; if it wants them, it may be set down as inoffensive. I am not ignorant that many serpents are said to be dangerous whose jaws are unfurnished with fangs; but it is most probable that our terrors only have furnished these animals with venom; for of all the tribe whose teeth are thus formed, not one will be found to have a bag for containing poison, nor a conduit for injecting it into the wound. The Black Snake, the Liboya, the Blind Worm, and a hundred others that might be mentioned, have their teeth of an equal size, fixed into the jaws, and with no other apparatus for inflicting a dangerous wound than a dog or a lizard: but it is otherwise with the venomous tribe we are now describing; these are well furnished, not only with an elaboratory where the poison is formed, but a canal by which it is conducted to the jaw, a bag under the tooth for keeping it ready for every occasion, and also an aperture in the tooth itself for injecting it into the wound. To be more particular: the glands that serve to fabricate this venomous fluid are situated on each side of the head behind the eyes, and have their canals leading from thence to the bottom of the fangs in the upper jaw, where they enter into a kind of bladder, from whence the fangs on each side are seen to grow. The venom contained in this bladder is a yellowish thick tasteless liquor, which injected into the blood is death, yet which may be swallowed without any danger.

The fangs that give the wound come next under observation; they are large in proportion to the size of the animal that bears them; crooked, yet sharp enough to inflict a ready wound. They grow one on each side, and sometimes two, from two movable bones in the upper jaw, which by sliding backward or forward, have a power of erecting or depressing the teeth at pleasure. In these bones are also fixed many teeth, but no way venomous, and only serving to take and hold the animal's prey. Besides this apt disposition of the fangs, they are hollow within and have an opening towards the point, like the slit of a pen, through which, when the fang is pressed

down upon the bladder where it grows, there is seen to issue a part of the venom that lay below. To describe this operation at once: when the serpent is irritated to give a venomous wound, it opens its formidable jaws to the widest extent; the movable bones of the upper jaw slide forward; the fangs that lay before inclining are thus erected; they are struck with force into the flesh of the obnoxious person; by meeting resistance at the points, they press upon the bladders of venom from whence they grow; the venom issues up through the hollow of the tooth, and is pressed out through its slit into the wound, which by this time the tooth has made in the skin. Thus from a slight puncture, and the infusion of a drop of venom scarcely larger than the head of a pin, the part is quickly inflamed, and, without a proper antidote, the whole frame contaminated.

The appearance which this venom produces are different, according to the serpent that wounds, or the season, or the strength of the animal that strikes the blow. If a viper inflicts the wound, and the remedy be neglected, the symptoms are not without danger. It first causes an acute pain in the place affected, attended with a swelling, first red, and afterwards livid. This by degrees spreads to the neighbouring parts; great faintness, and a quick, though low and interrupted, pulse ensues; to this succeed great sickness at the stomach, bilious and convulsive vomitings, cold sweats, pains about the navel, and death itself. But the violence of these symptoms depends much on the season of the year, the difference of the climate, the size or rage of the animal, and the depth and situation of the wound. These symptoms are much more violent, and succeed each other more rapidly, after the bite of a rattle-snake; but when the person is bit by the cobra di capello, he dies in an hour, his whole frame being dissolved into a putrid mass of corruption.

Nothing surely can more justly excite our wonder, than that so small a quantity of venom should produce such powerful and deadly effects. If the venom itself be examined through a microscope, it will be found to shoot into little crystals, that, to an imagination already impressed with its potency, look like so many darts fit for entering the blood-vessels, and wounding their tender coats. But all these darts are wholly of our own making: the softest, mildest fluid whatever, possessed of any consistency, will form crystals under the eye of the microscope, and put on an appearance exactly like the venom of the viper. In fact, this venom has no acrid taste whatever; and to all experiments that our senses can make upon it, appears a slimy insipid fluid. Charas, who often tasted it, assures us of the fact; and asserts, that it may be taken inwardly without any sensible effects, or any prejudice to the constitution. But the famous experiments that were tried by Rhedi and others in the presence of the Great Duke of Tuscany and his court, put this beyond any doubt whatsoever. By these it appeared, that the serpent having once bitten exhausted for that time the greatest part of its poison; and though the wound caused by its biting a second time was attended with some malignant symptoms, yet they were much milder than before. It appeared that the serpent biting upon a sponge, or a piece of soft bread, and then biting a dog immediately after, did not inflict a wound more dangerous than the prick of a needle. It appeared that the venom being collected, and a needle dipped therein, this produced almost as painful effects as the tooth of the animal itself. But what caused the greatest surprise in the court was, the seeming rashness of one Tozzi, a viper-catcher; who while the philosophers were giving elaborate lectures on the danger of the poison when taken internally, boldly desired a large quantity of it might be put together; and then, with the utmost confidence, drank it off before them all. The court was struck with astonishment, and expected that the man would instantly fall dead; but they soon perceived their mistake, and found that taken in this manner, the poison was as harmless as water; so true is that famous passage of Lucan,

> Noxia serpentum est admixto sanguine pestis:
> Morsu virus habent, et fatum in dente minantur:
> Pocula morte carent.

What then shall we say to the speedy effect of so seemingly harmless a liquid taken into the circulation? Let us first observe, that milk is one of the most mild and nourishing of all fluids, and seemingly the most friendly to the human constitution; yet if milk be injected into a vein, it will quickly become fatal, and kill with more certain destruction than even the venom of the viper. From hence then we may infer, that the introducing not only the serpentine venom, but also a quantity of any other mixture, into the circulation, will be fatal; and that, consequently, serpents kill as well by their power of injecting the wound as by the potency of their poison. Some indeed may inject a more acrimonious mixture, and this may produce more speedy effects; but any mixture thus injected would be dangerous, and many would be fatal.

Ray gives us an instance of the potency of the serpent-poison; which, though it has all the air of a fable, I cannot help transcribing. "A gentleman who went over to the East Indies, while he was one day sitting among some friends, was accosted by an Indian juggler, who offered to show him some experiments respecting the venom of serpents; an ex-

hibition usual enough in that country. Having first, therefore, produced a large serpent, he assured the company that it was harmless; and to convince them of what he said, he tied up his arm, as is usual with those who are going to be bled, and whipped the serpent till it was provoked to bite him. Having drawn in this manner about half a spoonful of blood from his arm, he put the congealed clot upon his thigh. He then took out a much smaller serpent, which was no other than the cobra di capello; and having tied up his neck, he procured about half a drop of its venom, which he sprinkled on the clot of blood on his thigh, which instantly began to ferment and bubble, and soon changed colour from a red into a yellow."

This he pretended was caused by the extreme malignity of that animal's venom: however, I have no doubt that the whole is either a fable, or a trick of the Indian; who, while he seemed to mix the serpent's venom, actually infused some stronger ingredient, some mineral acid, into the mass of blood, which was capable of working such a change. It cannot be supposed that any animal poison could act so powerfully upon the blood already drawn and coagulated; for a poison that could operate thus instantaneously upon cold blood, could not fail of soon destroying the animal itself.

Be this as it will, the effects of serpent-poison are but too well known, though the manner of operation be not so clear. As none of this malignant tribe grow to a great size, the longest of them not exceeding nine feet, they seldom seek the combat with larger animals, or offend others till they are first offended. Did they exert their malignity in proportion to their power, they could easily drive the ranks of Nature before them; but they seem unconscious of their own superiority, and rather fly than offer to meet the meanest opposer. Their food chiefly consists of small prey, such as birds, moles, toads, and lizards; so that they never attack the more formidable animals, that would seldom die unrevenged. They lurk therefore in the clefts of rocks, or among stony places; they twine round the branches of trees, or sun themselves in the long grass at the bottom. There they only seek repose and safety. If some unwary traveller invades their retreats, their first effort is to fly; but when either pursued or accidentally trod upon, they then make a fierce and fatal resistance. For this purpose they raise themselves according to their strength upon their tail, erect the head, seize the limb that presses them, the wound is given, and the head withdrawn in a moment. It is not therefore without reason, that the Asiatics, who live in regions where serpents greatly abound, wear boots and long clothes, which very well protect their lower parts from the accidental resentment of their reptile annoyers.

In the eastern and western Indies, the numbers of noxious serpents are various; in this country we are acquainted only with one.[1] The viper is the only animal in Great Britain from whose bite we have any thing to fear. In the tropical climates, the rattlesnake, the whip-snake, and the cobra di capello, are the most formidable, though by no means the most common, From the general notoriety of those particular serpents, and the universal terror which they occasion, it would seem that few others are possessed of such powerful malignity.

Vipers are found in many parts of this island; but the dry, stony, and particularly the chalky countries, abound with them.[2] This animal

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[1] It is a curious fact, that since the introduction of sheep farming into the Highlands of Scotland, the number of vipers has greatly diminished there. This is owing to the flocks of sheep trampling them to death as they go along. Formerly the viper used to be very destructive to cattle, by biting them in the udder as they lay down: from this the sheep are protected by their wool.

[2] *Common Viper* or *Adder.*—The *Common Viper* is



happily the sole British representative of any of the poisonous groups of Serpents, and indeed the only poisonous reptile indigenous to this country. It is far more numerous in Scotland than the Common Snake, and is found in abundance in all parts of England and Wales, frequenting heaths, dry woods, and banks. In Ireland it has never been seen; and it may, almost with certainty, be stated that it does not exist there. On the continent of Europe it is extensively distributed, being found from the northern parts of Russia to the south of Italy and Spain. It is everywhere deservedly feared on account of its venom, which, although less virulent than that of many other species, is yet sufficiently so to produce severe symptoms, and sometimes, in the warmer climates, even fatal results. In this country I have never seen a case which terminated in death, nor have I been able to trace to an authentic source any of the numerous reports of such a termination, which have at various times been confidently promulgated. At the same time the symptoms are frequently so threatening, that I cannot but conclude that in very hot weather, and when not only the reptile is in full activity and power, but the constitution of the victim in a state of great irritability and diminished power, a bite from the Common Viper would very probably prove fatal. The remedies usually employed are the external application of oil, and the internal administration of ammonia.

The poisonous fluid is perfectly innocuous when swallowed. Dr Mead, and others, have made this experiment, and never experienced the slightest ill effects from it. It is, however, clear that there would be danger in swallowing it, were any part of the mouth, the throat, or the œsophagus, in a state of ulceration, or having an abraded surface.

It will not perhaps be wholly uninteresting to describe briefly the very beautiful apparatus by which the poison wounds are inflicted, which render these, and so many other serpents, so formidable. On each side of

seldom grows to a greater length than two feet; though sometimes they are found above three. The ground colour of their bodies is a dirty yellow; that of the female is deeper. The back is marked the whole length with a series of rhomboid black spots, touching each other at the points; the sides with triangular ones; the belly entirely black. It is chiefly distinguished from the common black snake by the colour, which in the latter is more beautifully mottled, as well as by the head, which is thicker than the body; but particularly by the tail, which in the viper, though it ends in a point, does not run tapering to so great a length as in the other. When, therefore, other distinctions fail, the difference of the tail can be discerned at a single glance.

The viper differs from most other serpents in being much slower, as also in excluding its young completely formed, and bringing them

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the upper jaw, instead of the outer row of teeth which are found, in nonvenomous serpents, there exist two or three, or more, long, curved, and tubular teeth, the first of which is larger than the others, and is attached to a small movable bone, articulated to the maxillary bone, and moved by a muscular apparatus, by which the animal has the power of erecting it. In a state of rest the fang reclines backwards along the margin of the jaw, and is covered by a fold of skin; but when about to be called into use, it is erected by means of a small muscle, and brought to stand perpendicular to the bone. The tooth itself is as it were perforated by a tube, the mode of formation of which was not understood until it was demonstrated by Mr Smith in the Philosophical Transactions for 1818. This tube, although completely enclosed, excepting at its basal and apical orifices, must be considered as formed merely by the closing round of a groove in the external part of the tooth itself, and hence not in any way connected with the inner cavity of the tooth, in which exists the pulp upon which the substance of the tooth is formed. The base of the tooth, and consequently the basal orifice of the tube just described, is embedded in a sac, into which the poison is poured from the ducts of the glandular structure by which it is secreted, and which is believed to represent the parotid gland of the higher vertebrata. The poisonous fluid itself is indorous, tasteless, and of a yellow colour. It is secreted in greater quantity, and its qualities are more virulent in a high temperature than in cold. Its secretion may be greatly increased by local irritation; as is evidenced by the following fact. Some years since I was dissecting very carefully and minutely the poison apparatus of a large rattlesnake, which had been dead for some hours; the head had been taken off immediately after death; yet as I continued my dissection the yellow poison continued to be secreted so fast as to require to be occasionally dried off with a bit of rag or sponge; I believe that there could not have been less altogether than six or eight drops at the least.

When the animal inflicts the wound, the pressure on the tooth forces a small drop of the poison through the tube; it passes through the external orifice, which is situated on the concave side of the curved tooth, and is in the form of a slit. The manner in which the blow is inflicted is as follows. The animal generally throws itself in the first place into a coil more or less close, and the anterior part of the body is raised. The neck is bent somewhat abruptly backwards, and the head fixed almost horizontally. In an instant the head is, as it were, launched by a sudden effort towards the object of its anger, and the erected tooth struck into it, and withdrawn with the velocity of thought. It is found by experiment that the effect of subsequent wounds is greatly diminished either by the diminution of the quantity of venom, or by some deterioration of its strength; so that if a venomous serpent be made repeatedly to inflict wounds, without allowing sufficiently long intervals for it to recover its powers, each successive bite becomes less and less effective. A gentleman of my acquaintance had some years since received a living rattlesnake from America. Intending to try the effects of its bite upon some rats, he introduced one of these animals into the cage with the serpent; it immediately struck the rat, which died in two minutes. Another rat was then placed in the cage; it ran to the part of the cage furthest from the serpent, uttering cries of distress. The snake did not immediately attack it; but after about half an hour, and on being irritated, it struck the rat, which did not exhibit any symptoms of being poisoned for several minutes, and died at twenty minutes after the bite. A third, and remarkably large rat, was then introduced into the cage. It exhibited no signs of terror at its dangerous companion, which, on its part, appeared to take no notice of the rat. After watching for the rest of the evening, my friend retired, leaving the serpent and the rat together; and on rising early the next morning to ascertain the fate of his two heterogeneous prisoners, he found the snake dead, and the muscular part of its back eaten by the rat. I do not remember at what time of the year this circumstance took place, but I believe it was not during very hot weather.

Although there is no reason to believe that the viper employs this powerful means of destruction for the purpose of disabling its prey before it is finally seized; but, on the contrary, all the observations which have been made upon its mode of feeding, tend to show that, like the snake, it seizes its prey at once, and immediately begins to swallow it; yet it is not at all improbable, considering how instantaneously the poison begins to affect small animals, that even in the act of seizing a mouse or bird, or any other victim, it may instil a sufficient quantity of venom into its system to paralyze and presently destroy it. Still the action by which it takes its prey is very different from that which it employs in its defensive attack, and resembles that employed by the innocuous tribes. Its favourite food consists of the smaller mammalia, field-mice, shrews, and similar little animals, of frogs also, though less commonly, and occasionally of birds. It does not always confine its voracity within the limits of its powers of deglutition; for I have in my possession a specimen of a small viper which was taken on Poole Heath in Dorsetshire, in a dying state, in the act of attempting to swallow a mouse which was too large for it, the skin of the neck being so distended as to have burst in several places.

The viper, like the other reptilia, seeks a secret and secure place in which to hibernate during the cold months of the year. Here several are found entwined together, and in a very torpid condition; and if at this period a viper be made to wound an animal with its poison-fang, no injury is likely to result from it; the poison either does not exist at all, or it is inert.

It frequents dry sandy heaths and waste places, not requiring, like the snake, the neighbourhood of water, nor swimming so readily as that species. In many parts of the country it is even more common than the snake.

The name Adder, by which it is known in many parts of England and Scotland, is anciently written *nedre*, and afterwards *eddre*, the initial *n* being dropped. It is from the Anglo Saxon *nædre*,—neither, lower,—from its creeping position, and the name was applied to all the Serpent tribe. The word Viper, Latin *Vipera*, is derived from its viviparous habit.—*Bell's British Reptiles.*

forth alive. The kindness of Providence seems exerted, not only in diminishing the speed, but also the fertility, of this dangerous creature. They copulate in May, and are supposed to be about three months before they bring forth, and have seldom above eleven eggs at a time. These are of the size of a blackbird's egg, and chained together in the womb like a string of beads. Each egg contains from one to four young ones; so that the whole of a brood may amount to about twenty or thirty. They continue in the womb till they come to such perfection as to be able to burst from their shell; and they are said by their own efforts to creep from their confinement into the open air, where they continue for several days without taking any food whatsoever. "We have been assured," says Mr Pennant, "by intelligent people, of the truth of a fact, that the young of the viper, when terrified, will run down the throat of the parent and seek shelter in its belly, in the same manner as the young of the opossum retire into the ventral pouch of the old ones. From this," continues he, "some have imagined, that the viper is so unnatural as to devour its own young; but this deserves no credit, as these animals live upon frogs, toads, lizards, and young birds, which they often swallow whole, though the morsel is often three times as thick as their own body."

The viper is capable of supporting very long abstinence, it being known that some have been kept in a box six months without food; yet during the whole time they did not abate of their vivacity. They feed only a small part of the year, but never during their confinement; for if mice, their favourite diet, should at that time be thrown into their box, though they will kill, yet they will never eat them. When at liberty, they remain torpid throughout the winter; yet, when confined, have never been observed to take their annual repose. Their poison, however, decreases in proportion to the length of their confinement; and it is thought that the virtues of the animal's flesh, are, by the same restraints, considerably lessened.

They are usually taken with wooden tongs, by the end of the tail, which may be done without danger; for, while held in that position, they are unable to wind themselves up to hurt their enemy: yet, notwithstanding this precaution, the viper-catchers are frequently bit by them; but, by the application of salad oil, the bite is effectually cured.

One William Oliver, a viper-catcher at Bath, was the first who discovered this admirable remedy. On the first of June, 1735, in the presence of a great number of persons, he suffered himself to be bit by an old black viper, (brought by one of the company,) upon the wrist and joint of the thumb of the right hand, so that drops of blood came out of the wounds: he immediately felt a violent pain, both at the top of his thumb and up his arm, even before the viper was loosened from his hand; soon after he felt a pain, resembling that of burning, trickle up his arm; in a few minutes his eyes began to look red and fiery, and to water much; in less than an hour he perceived the venom seize his heart, with a pricking pain, which was attended with faintness, shortness of breath, and cold sweats; in a few minutes after this, his belly began to swell, with great gripings, and pains in his back, which were attended with vomitings and purgings: during the violence of these symptoms, his sight was gone for several minutes, but he could hear all the while. He said, that in his former experiments he had never deferred making use of his remedy longer than he perceived the effects of the venom reaching his heart; but this time, being willing to satisfy the company thoroughly, and trusting to the speedy effects of his remedy, which was nothing more than olive-oil, he forbore to apply any thing till he found himself exceeding ill and quite giddy. About an hour and a quarter after the first of his being bit, a chafing dish of glowing charcoal was brought in, and his naked arm was held over it, as near as he could bear, while his wife rubbed in the oil with her hand, turning his arm continually round, as if she would have roasted it over the coals: he said the poison soon abated, but the swelling did not diminish much. Most violent purgings and vomitings soon ensued; and his pulse became so low, and so often interrupted, that it was thought proper to order him a repetition of cordial potions: he said he was not sensible of any great relief from these; but that a glass or two of olive-oil drank down, seemed to give him ease. Continuing in this dangerous condition, he was put to bed, where his arm was again bathed over a pan of charcoal, and rubbed with salad oil, heated in a ladle over the charcoal, by Dr Mortimer's direction, who was the physician that drew up the account. From this last operation he declared that he found immediate ease, as though by some charm: he soon after fell into a profound sleep, and, after about nine hours' sound rest, awaked about six the next morning, and found himself very well; but in the afternoon, on drinking some rum and strong beer, so as to be almost intoxicated, the swelling returned, with much pain and cold sweats, which abated soon, on bathing the arm, as before, and wrapping it up in brown paper soaked in the oil.[1]

[1] The treatment for the bite of the viper has been very well indicated by Celsus in his treatise of medicine, and it merits some attention, especially as naturalists are frequently exposed to accidents from this reptile. The first precaution to be observed in a case of this kind, is, when

Such are the effects of the viper's bite; yet its flesh has long been celebrated as a noble medicine. A broth, made by boiling one viper in a quart of water till it comes to a pint, is the usual method in which it is given at present; and it is said to be a very powerful restorative in battered constitutions; the salt of vipers is also thought to exceed any other animal salt whatever, in giving vigour to the languid circulation, and prompting to venery.

The Rattle-snake is bred in America, and in no part of the old world. Some are as thick as a man's leg, and six feet in length; but the most usual size is from four to five feet long. In most particulars it resembles the viper; like that animal having a large head and a small neck, being of a dusky colour, and furnished with fangs that inflict the most terrible wounds. It differs, however, in having a large scale, which hangs like a pent-house over each eye. The eye also is furnished with a nictitating membrane, that preserves it from dust; and its scales are of a considerable degree of hardness. They are of an orange, tawny, and blackish colour on the back; and of an ash-colour on the belly, inclining to lead. The male may be readily distinguished from the female, by a black velvet spot on the head, and by the head being smaller and longer. But that which, besides their superior malignity, distinguishes them from all other animals, is their rattle, an instrument lodged in their tail, by which they make such a loud rattling noise, when they move, that their approach may readily be perceived, and the danger avoided. This rattle, which is placed in the tail, somewhat resembles, when taken out of the body, the curb-chain of a bridle: it is composed of several thin, hard, hollow bones, linked to each other, and rattling upon the slightest motion. It is supposed by some that the snake acquires an additional bone every year; and that, from hence, its age may be precisely known: however this may be, certain it is, that the young snakes, of a year or two old, have no rattles at all: while many old ones have been killed, that had from eleven to thirteen joints each. They shake and make a noise with these rattles with prodigious quickness, when they are disturbed: however, the peccary and the vulture are no way terrified at the sound, but hasten, at the signal, to seize the snake, as their most favourite prey.

It is very different with almost every other animal. The certain death which ensues from this terrible creature's bite, makes a solitude wherever it is heard. It moves along with the most majestic rapidity;[1] neither seeking to offend the larger animals, nor fearing their insults. If unprovoked, it never meddles with any thing but its natural prey; but when accidentally trod upon, or pursued to be

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the disposition of the parts will permit, to fix a ligature above the wounded place, and not to tighten it too much, for fear of giving rise to mortification. Immediately after, a cupping-glass is applied on the wound, the parts adjacent being first scarified, and this mode, highly praised by Celsus, has very recently been attended with happy results in the hands of Messrs Mangili, Barry, and Bouillaud. This method, from analogy, affords an additional recommendation to employ the plan of suction, which has received the further confirmation of professional experiments tried by a number of physiologists and physicians. When the cupping-glass has performed its office, the lips of the wound, already scarified, should be cauterized deeply and extensively. This should be done with a red-hot iron, chlorine of antimony, or concreted potassium. A variety of different substances, taken internally, has been lauded from time to time as efficacious against the bite of the viper. Sudorifics have been especially recommended, and among them the flesh of the lizard, of the coluber, and the viper itself, have been preferred, in consequence of the great quantity of ammonia which it has been ascertained to contain. An alexipharmic virtue of the same kind has been also attributed to theriaca and other analogous electuaries.

The *Chersæa* (*Swedish viper*, Shaw) is common in the environs of Upsal, in Sweden: also in Smaland, Scania, and Pomerania, where it retires into thickets, under hedges, and to the foot of tufted trees. It is sometimes seen in Prussia, Poland, Denmark, and in the Pyrenees. In Sweden it is known under the name of *æsping*, which seems evidently a corruption of *aspic*, and it has been sometimes called the *red viper*. It is erroneously located by Linnæus, Wolf, and Laurenti, in the genus coluber. Its resemblance to the common viper is very striking. The chersæa of Sweden is a small reptile, about six inches long, and as thick as one's little finger. That of Switzerland and France differs from it much both in size and number of plates. Herpetologists, however, admit the identity of these animals, and make but one species of them. Be this as it may, the Swedish viper is a reptile of the most dangerous kind. Its bite is often mortal, and its deleterious effects are manifested with greater rapidity than those which follow from the bite of the common viper.

The *Ammodytes* is a native of all the south of Europe. It is found in Dauphine, and in the neighbourhood of Lyons in France, and in the east of Europe, in the mountains of Illyria. It habitually frequents the rocks which border on the Danube, the neighbourhood of the city of Gorice and the Japidian mountains. This reptile passes the winter concealed in clefts and crevices of rocks, from which it issues forth when the warmer rays of the sun announce the return of spring. Then it casts its skin, and the time of reproduction begins. Its habitual food differs in nothing from that of the common viper, and its bite is not less dangerous.

The *Cerastes* has received its name from the Greek word *κέρας*, in consequence of the eminences which surround its eyes, and which, from the most ancient times, have been erroneously compared to the horns of mammiferous animals. Shunning humid and marshy situations, it is found only in the burning and arid sands of Egypt, Arabia, and Syria—sands in which it remains concealed during the entire day, and notwithstanding its great agility, it waits patiently until some victim presents itself to its insatiable voracity. It sometimes in this way gets possession of the jerboa, whose hole, according to Bruce, is very often contiguous to its own.

[1] This is an error: the movements of the rattle-snake are extremely sluggish.

destroyed, it then makes a dreadful and desperate defence. It erects itself upon its tail, throws back its head, and inflicts its wound in a moment; then parts and inflicts a second wound: after which, we are told by some, that it remains torpid and inactive, without even attempting to escape.

The very instant the wound is inflicted, though small in itself, it appears more painful than the sting of a bee. This pain, which is so suddenly felt, far from abating, grows every moment more excruciating and dangerous: the limb swells; the venom reaches the head, which is soon of a monstrous size; the eyes are red and fiery; the heart beats quick, with frequent interruptions; the pain becomes insupportable, and some expire under it in five or six hours; but others, who are of stronger constitutions, survive the agony for a few hours longer, only to sink under a general mortification, which ensues, and corrupts the whole body.[1]

As a gentleman in Virginia was walking in the fields for his amusement, he accidently trod upon a rattle-snake, that had been lurking in a stony place; which, enraged by the pressure, reared up, bit his hand, and shook its rattles. The gentleman readily perceived that he was in the most dreadful danger; but, unwilling to die unrevenged, he killed the snake, and carrying it home in his hand, threw it on the ground before his family, crying out, "I am killed, and there is my murderer." In such an extremity, the speediest remedies were the best. His arm, which was beginning to swell, was tied up near the shoulder, the wound was anointed with oil, and every precaution taken to stop the infection. By the help of a very strong constitution he recovered; but not without feeling the most various and dreadful symptoms for several weeks together. His arm, below the ligature, appeared of several colours, with a writhing among the muscles, that, to his

[1] *Death by the bite of a Rattle-snake.*—At the meeting of the Academy of Sciences of France on the 9th of April, 1827, some documents were presented by M. Dumerel, connected with the death of Mr Drake by the bite of a rattle-snake, forming part of a collection of reptiles which that person had exhibited at London, and had taken to France for the same purpose. These documents were transmitted to the Academy by the Minister of the Interior; and seem to have excited fears in some of the members, lest, the climate of France being favourable, some of these dangerous reptiles might escape and propagate.

From these documents it appears, that Mr Drake arrived at an inn in Rouen on the 8th of February, with three live rattle-snakes and some young crocodiles, and that, notwithstanding his care to preserve them from cold on the road, he saw with grief on his arrival that the finest of the three was dead. The dead animal was removed from the cage, and the cage itself, with the other two, were taken into the dining-room, and placed near the stove. Here Mr Drake endeavoured to rouse them with a stick; but, perceiving that one of the two gave no signs of animation, he opened the cage, took the serpent by the head and tail, and approaching a window to ascertain by handling if life was extinct, the animal turned its head half round, and fixed one of its fangs in the posterior external part of the left hand. Mr Drake shrieked, pronounced some words in English, according to the report, and was replacing the serpent in the cage, when it again bit him on the palm of the same hand. Mr Drake now ran out into the court calling eagerly for a surgeon: and, not finding water readily, rubbed his hand upon some ice, which he found at the door. Two minutes after, having procured a cord, he himself made a ligature on the arm above the hand. Notwithstanding these precautions, his agitation from the fear of the consequences continued to increase till the arrival of Dr Pihorel. The presence of this gentleman somewhat composed the feelings of Mr Drake; and he saw with eager joy the chafing-dish and irons arrive, with which the wounds were to be cauterized. This operation was instantly performed, and the patient took internally half a glassful of olive oil. Drake seemed now to have resumed his tranquillity. But in a few minutes more symptoms made their appearance which rendered the case hopeless, and he died in eight hours and three quarters after the bites.

The body was afterwards opened. The internal organs appeared healthy; the brain and spinal cord were unaltered. The membrane which covered these parts, however, was observed to have a reddish tinge. The veins presented no trace of inflammation; and the only appearance of derangement in the system, consisted in the veins of the affected side having the blood curdled or clotted.

In a curious memoir on the habits of the rattle-snake, read by M. Audubon at the Wernerian Society, that gentleman mentioned a circumstance which tends to show that the poisonous fangs of this reptile, even when withdrawn from the animal, retain their virulence for years. A person had been bitten by a rattle-snake in the wood, through a strong boot. He died without the cause of his death being properly investigated. The boots descended to his son, who, after putting them on, was taken suddenly ill, and also died. The effects of this last were brought to sale; and a younger brother fancying the boots, or willing to preserve some memorial of his father and brother, was the purchaser. He used them only once, when he also fell ill and died. The medical men, whom such an occurrence had led to investigate its cause, at last ripped up the fatal boot, and found, firmly fixed in the substance of the leather, the fang of the rattle-snake, which had thus caused the death of three individuals. Rattle-snakes, M. Audubon further observed, are often found coiled up and torpid when the temperature is low; and he himself once narrowly escaped from perhaps a serious accident, in trusting to their continued torpidity. He had found an excellent specimen coiled up and torpid, which he put in his knapsack along with some wild ducks which he had shot. The motion and heat of his body, together with the additional heat afforded by a sportsman's fire at a repast in the woods, had, however, revived the animal; and the motions of his knapsack, observed from the outside, indicated life within. M. Audubon at first thought that some of his ducks, imperfectly killed, had found their situation irksome, and were testifying their impatience; but the recollection of the rattle-snake flashing at once on his mind, he threw off his bag, duck, and reptile, altogether. The removal of the animal to a colder temperature brought on again its torpidity. He carried the snake home; and the identical specimen, if we rightly understood him, is now in the Museum of the Lyceum of Natural History of New York.—*Brewster's Jour.*

terrified imagination, appeared like the motions of the animal that wounded him. A fever ensued; the loss of his hair, giddiness, drought, weakness, and nervous faintings; till, by slow degrees, a very strong habit overpowered the latent malignity of the poison.

Several remedies have been tried to alleviate this calamity. A decoction of the Virginian snake-root is considered as the most effectual; and at the same time the head of the animal, bruised and laid upon the part affected, is thought to assist the cure. In general, however, it is found to be fatal: and the Indians, sensible of this, take care to dip their arrows in the poison under the rattle-snake's fangs, when they desire to take a signal revenge of their enemies.

Thus much concerning this animal is agreed upon by every naturalist: there are other circumstances in its history, which are not so well ascertained. And first, its motion, which some describe as the swiftest imaginable; asserting, that its Indian name of *Ecacoalt*, which signifies the wind-serpent, implies its agility: others, on the contrary, assert that it is the slowest and the most sluggish of all serpents; and that it seldom moves from one place. In this opposition of opinions, there are others, who assert, that on even ground it moves but slowly; but then, among rocks, that it goes at a great rate. If we may argue from analogy, the opinion of those who contend for its slow motion, seems the most probable; as the viper, which it so very much resembles, is remarkable among serpents for its inactivity.

It is said also by some, that the rattle-snake has a power of charming its prey into his mouth; and this is as strongly contradicted by others. The inhabitants of Pennsylvania are said to have opportunities of observing this strange fascination every day. The snake is often seen basking at the foot of a tree, where birds and squirrels make their residence. There, coiled upon its tail, its jaws extended, and its eyes shining like fire, the rattle snake levels its dreadful glare upon one of the little animals above. The bird or the squirrel, whichever it may be, too plainly perceives the mischief meditating against it; and hops from branch to branch, with a timorous plaintive sound, wishing to avoid, yet incapable of breaking through the fascination: thus it continues for some time its feeble efforts and complaints, but is still seen approaching lower and lower towards the bottom branches of the tree, until, at last, as if overcome by the potency of its fears, it jumps down from the tree directly into the throat of its frightful destroyer.[1]

In order to ascertain the truth of this story, a mouse was put into a large iron cage, where a rattle-snake was kept, and the effects carefully observed. The mouse remained motionless at one end of the cage; while the snake, at the other, continued fixed, with its eye glaring full on the little animal, and its jaws opened to their widest extent: the mouse for some time seemed eager to escape; but every effort only served to increase its terrors, and to draw it still nearer the enemy; till, after several ineffectual attempts to break the fascination, it was seen to run into the jaws of the rattle-snake, where it was instantly killed.

To these accounts the incredulous oppose the improbability of the fact: they assert, that such a power ascribed to serpents, is only the remnant of a vulgar error, by which it was supposed that serpents could be charmed, and had also a power of charming. They aver, that animals are so far from running down the throat of a rattle-snake in captivity, that the snake will eat nothing in that state, but actually dies for want of subsistence.

A serpent, called the Whip-snake, is still more venomous than the former. This animal, which is a native of the East, is about five feet long, yet not much thicker than the thong of a coachman's whip. It is exceedingly venomous; and its bite is said to kill in about six hours. One of the Jesuit missionaries, happening to enter into an Indian pagoda, saw what he took to be a whipcord lying on the floor, and stooped to take it up; but, upon handling it, what was his surprise to find that it was animated, and no other than the whip-snake, of which he had heard such formidable accounts: fortune, however, seemed favourable to him, for he grasped it by the head, so that it had no power to bite him, and only twisted its folds up his arm. In this manner he held it, till it was killed by those who came to his assistance.

To this formidable class might be added the Asp, whose bite, however, is not attended with those drowsy symptoms which the ancients ascribed to it. The Jaculus of Jamaica also is one of the swiftest of the serpent kind. The Hæmorrhois, so called from the *hæmorrhages* which its bite is said to produce; the Seps,[2] whose

[1] The power said to be possessed by the Rattle-snake of fascinating its prey, has been the theme of many an astonishing tale, and the possession of this faculty is still believed by many. There is no doubt that the smaller animals on which the reptile subsists are alarmed in the presence of their known enemy, and that fear may cause them to lose their self-possession, and thus they are more readily seized by their cunning opponent.

[2] *The Seps.*—This word, which comes from a Greek word, signifying *to corrupt*, was used by the ancients to designate an animal which some considered a lizard and others a serpent.

The Seps is no longer considered to be a lizard, neither is it quite a serpent. Its lengthened body gives, at

wound is very venomous, and causes the part affected to corrupt in a very short time; the Coral Serpent, which is red, and whose bite is said to be fatal. But of all others, the Cobra di Capello, or Hooded Serpent, inflicts the most deadly and incurable wounds.[1] Of this formidable creature there are five or six different kinds; but they are all equally dangerous, and their bite followed by speedy and certain death. It is from three to eight feet long, with two large fangs hanging out of the upper jaw. It has a broad neck, and a mark

first sight, a striking resemblance to the Blind-worm, but on closer examination it is found to possess two pair of such very short paws, that they cannot possibly reach the ground.

This animal belongs to the family of the *Scinoides*, which are all distinguished by the extreme smallness of their members, and of which some species present very remarkable peculiarities. Some Seps are only provided with one toe on each foot; the bipeds possess only one pair of paws, situated at the hinder part of their body; the foremost paws only are observable in the *bimanus*.

One species inhabits the southern part of France, but is rare; in the north it is entirely unknown. In Italy, where it is more common, it is known by the name of *Cicella* or *Ciciqua*. The scales of its belly are separated from those of its back by three lines. This reptile is not dangerous, for nature has not bestowed upon it any venom, and even if it possessed any, its mouth is too small for it to bite a man, or any other large animal.

[1] The *naja* or *cobra di capello* is equally remarkable



for the elegance of its form, the strength of its body, and the danger which accompanies its bite. It has received the name of spectacle snake, in consequence of a black mark which more or less exactly represents spectacles on the extensible portion of its neck. When the animal is in a state of repose, the neck has no greater a diameter than the head, but under the influence of passion, the skin of this part extends in the form of a coif or hood. This serpent inhabits Coromandel, and is not found in Peru or Mexico, as many modern naturalists have erroneously stated, after Seba. It is very formidable from its envenomed bite, which is as dangerous as that of any other species of reptiles. When surprised by some imprudent traveller, it slowly raises its head, swells its neck, and advances against its aggressor in undulating movements executed solely by the tail.

In the sixth volume of the "Asiatic Researches," Mr Boaz, after having examined with care the ancient curative processes for the bite of venomous serpents, recommends in the last place as a specific in the dreadful malady caused by the poison of the cobra di capello, nitrate of silver, which was a remedy long since proposed by Fontana in the case of the viper. In the second volume of the same collection, Mr J. Williams has inserted a paper on the caustic volatile alkali against the deleterious effects of the bite of different serpents, and particularly that of the cobra di capello. It seems that this medicament should be applied both externally on the wound, and at the same time administered internally. A remedy much boasted of by some of the ancient missionaries, who had travelled in the East Indies, and who pretended to cure the bite of the naja, as well as that of other venomous animals, has been proved useless by the experiments of the learned Redi. This is a calculous concretion, which according to them is formed near the head, or in the body of the serpent in question, and which is named serpent or cobra-stone. This account of the origin of this pretended stone is assuredly false, and it is nothing but a factitious medicament composed by some charlatan. It appears to be nothing but a blackish or greenish argillaceous earth, which has the property of absorbing with great facility the humours which are formed at the surface of any wound whatever. But in India it is believed to imbibe quickly the poison discharged recently into the body of an animal bitten by the naja.

The name of *aspic* has been given amongst all civilized nations to a serpent rendered ever memorable by the death of Cleopatra, whose beauty, glory, honours, and deplorable end, have occupied the historians and poets of all nations. It has been only since the expedition of the French to Egypt that the true species of the aspic has been ascertained. During the period of that expedition, the French philosophers attached to the army observed a species of ophidian, regarded as harmless by Linnæus and most herpetologists, but considered as extremely venomous by the traveller, Forskal. This serpent is called *haje* by the inhabitants, and recent travellers have incontestably proved that it is the true aspic of the ancients, which never inhabited Europe; for the reptile which some years since infested the forest of Fontainbleau, and was called by this name, was nothing but a variety of the common viper, and the *æsping* of the Swedes is quite another species from the one in question.

Forskal informs us that when the haje is provoked, it swells and extends its neck greatly, and then springs with a single bound upon its enemy. This habit of rearing up when it is approached, caused the ancient inhabitants of the countries watered by the Nile, to believe that this serpent guarded the fields which it inhabited. They made it in consequence the emblem of the protecting divinity of the world. They sculptured it on the two sides of a globe, on the portico of all their temples. It is often exhibited by the jugglers at Cairo, apparently metamorphosed into a rod or wand, which is done by pressing its nape with the finger, and thus causing a sort of catalepsy. They take care, however, to remove the fangs, which might cause very serious accidents.

The poison of the haje is excessively violent, and far more deleterious than that of the European viper, which it resembles in its yellowish tint, and its transparence. Forskal relates, that having taken a very small drop of it, and introduced it into a slight incision made in the thigh of a pigeon, he saw this unfortunate bird perish in a quarter of an hour in convulsions and vomitings. The modes adopted against the bite of the haje are the same, for the most part, as those used in the case of that of the viper, particularly cauterization by fire, alcholized potassum, &c., and the administration of sudorifics internally.—*Supplement to the English edition of Cuvier by Edward Griffith and others.*

Serpents in South Africa.—The late excellent Mr Thomas Pringle, whose residence in South Africa, though unproductive to himself in a pecuniary sense, was fertile in observation, and has added largely to our knowledge of that portion of the globe, gives the following account of the *Venomous Serpents* to be found there:—

"The serpents of South Africa (he says) commonly accounted the most dangerous, are the Cobra-Capello (or hooded snake), the Puff-Adder, and the Berg-Adder (or mountain snake). The first of these is exceedingly fierce and active, and sometimes, it is said, attains the formidable length of ten feet; I have, however, never

of dark brown on the forehead; which, when viewed frontwise, looks like a pair of spectacles; but behind, like the head of a cat. The eyes are fierce, and full of fire; the head is small, and the nose flat, though covered with very large scales, of a yellowish ash-colour; the skin is white, and the large tumour on the neck is flat, and covered with oblong,

met with any of much more than half that size. The cobra has been known to spring at a man on horseback, and to dart himself with such force as to overshoot his aim. The puff-adder, on the other hand, is a heavy and sluggish animal, very thick in proportion to its length, and incapable, when attacked in front, of projecting itself upon its enemy. To make amends, however, it possesses the faculty of throwing itself backward with perilous and unexpected effect; but its disposition is inert, and unless accidentally trod upon or otherwise provoked, it will seldom attack mankind. The berg-adder, though much smaller in size than either of the preceding, is generally considered not less deadly, and it is the more dangerous from its being less easily discovered and avoided.

"During a residence of six years in the interior of the Cape Colony, and in the course of various journeys through the interior (extending to upwards of three thousand miles), I have met with a considerable number of snakes; yet I do not recollect of ever being exposed, except in one instance, to any imminent hazard of being bit by any of them. On the occasion referred to I was superintending some Hottentots, whom I had employed to clear away a patch of thicket from a spot selected for cultivation, when one of the men, suddenly recoiling with signs of great alarm, exclaimed, that there was a cobra-capello in the bush. Not being at that time fully aware of the dangerous character of this species of snake, I approached to look at him. The Hottentots called out to me to take care, for he was going to spring. Before they had well spoken, or I had caught a view of the reptile, I heard him hiss fiercely, and then dart himself towards me amidst the underwood. At the same instant, instinctively springing backward to avoid him, I fell over a steep bank into the dry stony bed of a torrent; by which I suffered some severe bruises, but fortunately escaped the more formidable danger to which I had too incautiously exposed myself. The Hottentots then assailed the snake with sticks and stones, and forced him (though not before he had made another spring and missed one of them still more narrowly then myself) to take refuge up a mimosa tree. Here he became a safe and easy mark to their missiles, and was speedily beaten down, with a broken back, and consequently rendered incapable of farther mischief. The Hottentots having cut off his head, carefully buried it in the ground, a practice which they never omit on such occasions, and which arises from their apprehension of some one incautiously treading on the head of the dead snake, and sustaining injury from its fangs; for they believe that the deathful virus, far from being extinguished with life, retains its fatal energy for weeks, and even months afterwards. This snake measured nearly six feet in length, and was the largest cobra I have met with.

"My little Hottentot corporal, Piet (or Peter) Spandilly, who assisted in killing this cobra, had a still narrower escape from a small but venomous snake, of which I have forgotten the colonial appellation. Piet and his men (six soldiers of the Cape Corps, placed at that time under my direction for the protection of our remote settlement against the Caffres) slept in a tent adjoining to mine, pitched in a grove of mimosas on the brink of the Bavian's river; and one morning when he rose from his couch of dry grass, Piet felt some living creature moving about his thigh in the inside of his leathern trousers. Thinking it was only one of the harmless lizards which swarm in every part of South Africa, he did not at first much mind it, but came out to the open air, laughing, and shaking his limb to dislodge the vermin. But when a black wriggling snake came tumbling down about his naked ancles, poor Spandilly, uttering a cry of horror, kicked the reptile off, springing at the same moment nearly his own height from the ground; and, though he had in reality sustained no injury, could scarcely for some time be persuaded that he was not 'a gone man.'

"It is, in fact, from apprehensions of danger, or the instinct of self-defence, far more than from any peculiar fierceness or innate malignity, that the serpent race ever assail man or any of the larger animals. They turn, of course, against the foot that tramples or the hand that threatens them; but happily nature has not armed them, in addition to their formidable powers of destruction, with the disposition of exerting these powers from motives of mere wanton cruelty, or for purposes unconnected with their own subsistence or security. Were it otherwise, countries like the Cape would be altogether uninhabitable. As it is, the annoyance experienced from the numerous poisonous snakes is not such as, on the whole, to affect in any considerable degree the comfort of those accustomed to them.

"Conversing on this subject one day with my friend Captain Harding, who had been for many years a resident and magistrate in the interior, I inquired whether he had ever, in the course of his campaigns on the Caffre and Bushman frontiers, and when necessarily obliged to sleep in the desert or jungle in the open air, suffered injury or incurred danger from serpents—he replied, that the only occasion he recollected of incurring any great hazard of this sort, was the following:—

"'Being upon a military expedition across the frontier,' said he, 'I had slept one night, as usual, wrapt in my cloak, beneath a tree. On awaking at daybreak, the first object I perceived on raising my head from the saddle, which served for my pillow, was the tail of an enormous puff-adder lying across my breast, the head of the reptile being muffled under the folds of the cloak close to my body, whether it had betaken itself, apparently for warmth, during the chillness of the night. There was extreme hazard that if I alarmed it by moving, it might bite me in a vital part;—seizing it therefore softly by the tail, I pulled it out with a sudden jerk, and threw it violently to a distance. By this means I escaped without injury: but had I happened to have unwittingly offended this uninvited bedfellow before I was aware of his presence, I might in all probability have fatally atoned for my heedlessness.'

"It is not very unusual for snakes of various sorts to be found in the houses at the Cape, nor does it, in ordinary cases, excite any violent alarm when such inmates are discovered. They make their way both through the roofs and under the walls, in search of food and shelter, and especially in pursuit of mice, which many of them chiefly subsist upon. During my residence in the interior, however, I recollect only two instances of their being found in my own cabin. On one of these occasions I had sent a servant girl (a bare-legged Hottentot) to bring me some article from a neighbouring hut. It was after night-fall; and on returning with it, she cried out before entering the cabin—'Oh, Mynheer; Mynheer! what shall I do? A snake has twined itself round my ancles, and if I open the door he will come into the house.' 'Never mind,' I replied, 'open the door, and let him come if he dare.' She obeyed, and in glided the snake, luckily without having harmed the poor girl. I stood prepared, and instantly smote him dead; and afterwards found him to be one of the very venomous sort called *Nachtslang*.

smooth scales. The bite of this animal is said to be incurable, the patient dying in about an hour after the wound; the whole frame being dissolved into one putrid mass of corruption.

To remedy the bite of all these animals, perhaps salad oil would be very efficacious; however, the Indians make use of a composition, which is called in Europe, *Petro de Cobra*, or the *Serpent-stone;* and which applied to the

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"People get used to these things, and even Europeans by degrees come to regard them with much indifference. Just before leaving the colony, I spent a week or two with my friend Major Pigot, at his residence near Graham's Town; and going one day to take a book from some shelves in the drawing-room, I found a beautiful yellow snake, about five feet long, lying asleep upon the uppermost range of books. It lay so still that I at first thought it was a stuffed specimen; but perceiving a slight movement in its tail, I lent him such a thwack with a quarto volume as broke the poor fellow's back, and enabled me to demolish him at my leisure. I afterwards learned that another snake had been killed a few days previously in the very same spot, and a third in Major P.'s dressing-room. They had all entered through a loop hole which had casually been left open, and apparently had no other object in coming there (mousing apart) than literary seclusion.

"Such as these are no very uncommon occurrences, and as such pass even for subjects of jocularity amidst the adventures of a wild country. Instances, however, both frightful and revolting, sometimes occur.

"It is well known that the Bushmen, a tribe of wild Hottentots who inhabit the mountains and deserts of South Africa, imbue the points of their arrows in a strong and subtle poison, and that the venom of the most dangerous serpents to be found in that country forms a principal ingredient in its composition. The boldness and dexterity displayed by these wild huntsmen, and by many also of the colonial Hottentots, in searching out and seizing alive the formidable cobra-capello and puff-adder, are truly astonishing. Still more surprising is it to witness the snake-hunter extracting from the yet living and writhing reptile, held fast by his naked foot planted on its neck, the little bag containing the secreted venom, which the rage of the animal injects into the wound made by its fangs at the moment it strikes its victim,—to see him take this, and fearlessly drink its contents, as school-boys in England would suck the blob of the honey-bee! The swallowing of this venom, they conceive, renders them in time proof against its deleterious effects, when it is brought into immediate contact with the blood, whether by the bite of a snake or the barb of an arrow.

"Several of the most respectable Dutch colonists assured me, as a fact which had come within their own knowledge, that there are to be found among the wandering Bushmen persons whom they term *slang meesters* (snake masters), who actually possess the power of charming the fiercest serpents, and of readily curing their bite; and who pretend that they can communicate to others their mysterious powers and invulnerability, by putting them through a regular course of *poison-eating*.

"The more usual object, however, of the Bushman in catching serpents (exclusive of their value to him as an article of food), is to procure poison for his arrows. The animal venom, too thin and volatile to preserve its efficacy long unimpaired when used alone, is skilfully concocted into a black glutinous consistency, by the admixture of powerful vegetable and mineral poisons; the former being generally the juice of the root of a species of amaryllis, called by the boors, from this circumstance, the *gift-bol*, or poison-bulb; the latter, a bituminous or unctuous substance which is said to exude from certain rocks and caverns. With this deadly mixture the dwarfish and despised African anoints the desperate weapons with which he resists (though unavailingly) the aggressions of the colonists, and sometimes cruelly revenges the injuries they have inflicted."

To the above interesting account, by Mr Pringle, of the Serpents of South Africa, we may here add Mr Waterton's observations on the *Snakes of South America*, or, more properly, *Demerara*.

"Snakes," says that eccentric and enterprising naturalist, "are frequently met with in the woods betwixt the sea-coast and the rock Saba, chiefly near the creeks and on the banks of the river. They are large, beautiful, and formidable. The rattle-snake seems partial to a tract of ground known by the name of Canal, No. 3; there the effects of his poison will be long remembered.

"The *camoudi* has been killed from thirty to forty feet long; though not venomous, his size renders him destructive to the passing animals. The Spaniards in the Oroonoque positively affirm that he grows to the length of seventy or eighty feet, and that he will destroy the strongest and largest bull. His name seems to confirm this: there he is called 'matatoro,' which literally means 'bull killer.' Thus he may be ranked amongst the deadly snakes; for it comes nearly to the same thing in the end, whether the victim dies by poison from the fangs which corrupts his blood and makes it stink horribly, or whether his body be crushed to mummy, and swallowed by this hideous beast.

"The *whip-snake*, of a beautiful changing green, and the coral, with alternate broad traverse bars of black and red, glides from bush to bush, and may be handled with safety; they are harmless little creatures.

"The *labarri snake* is speckled, of a dirty brown colour, and can scarcely be distinguished from the ground or stump on which he is coiled up; he grows to the length of about eight feet, and his bite often proves fatal in a few minutes.

"Unrivalled in his display of every lovely colour of the rainbow, and unmatched in the effects of his deadly poison, the *counacouchi* glides undaunted on, sole monarch of these forests; he is commonly known by the name of the bush-master. Both man and beast fly before him, and allow him to pursue an undisputed path. He sometimes grows to the length of fourteen feet.

"A few small *caimen*, from two to twelve feet long, may be observed now and then in passing up and down the river; they just keep their heads above water, and a stranger would not know them from a rotten stump.

"Snakes in these wilds are certainly an annoyance, though, perhaps, more in imagination than reality, for you must recollect that the serpent is never the first to offend; his poisonous fang was not given him for conquest; he never inflicts a wound with it but to defend existence. Provided you walk cautiously, and do not absolutely touch him, you may pass in safety close by him. As he is often coiled up on the ground, and amongst the branches of the trees above you, a degree of circumspection is necessary, lest you unwarily disturb him. One morning I had been following a new species of parouquet, and the day being rainy, I had taken an umbrella to keep the gun dry, and had left it under a tree; whilst searching about for it I observed a young *coulacanara*, ten feet long, moving slowly onwards in a path where timber had formerly been dragged along; I saw he was not thick enough to break my arm in case he got twisted round it. There was not a moment to be lost. I laid hold of his tail with the left hand, one knee being on the ground; with the right I took off my hat,

wound, is said to draw out the venom. The composition of this stone, for it is an artificial substance, is kept a secret; and perhaps its effects in extracting the venom may be imaginary: nevertheless, it is certain that it has a power of sticking to the skin, and sucking a part of the blood from the wound. This it may do somewhat in the same manner as we see a tobacco-pipe stick to the lips of a man who is smoking; yet still we are ignorant of the manner; and the secret might probably be of some use in medicine. It were to be wished, therefore, that those who go to India would examine into this composition, and give us the result of their inquiries; but I fear that it is not to benefit mankind, that our travellers now go to India.

CHAP. III.

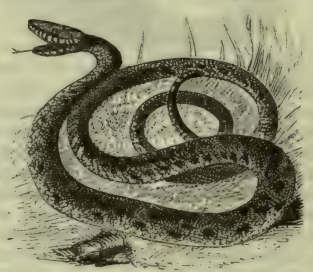
OF SERPENTS WITHOUT VENOM.

The class of serpents without poison may be distinguished from those that are venomous by their wanting the fang-teeth: their heads also are not so thick in proportion to their bodies; and, in general, they taper off to the tail more gradually in a point. But, notwithstanding their being destitute of venom, they do not cease to be formidable: some grow to a size by which they become the most powerful animals of the forest; and even the smallest and most harmless of this slender tribe find protection from the similitude of their form.

The fangs make the great distinction among serpents; and all this tribe are without them. Their teeth are short, numerous, and, in the smaller kinds, perfectly inoffensive: they lie in either jaw, as in frogs and fishes, their points bending backwards, the better to secure their prey. They want that artificial mechanism by which the poisonous tribe inflict such deadly wounds: they have no gland in the head for preparing venom: no conduits for conveying it to the teeth; no receptacles there: no hollow in the instrument that inflicts the wound. Their bite, when the teeth happen to be large enough to penetrate the skin (for, in general, they are too small for this purpose) is attended with no other symptoms than those of an ordinary puncture; and many of this tribe, as if sensible of their own impotence, cannot be provoked to bite, though never so rudely assaulted. They hiss, dart out their forky tongues, erect themselves on the tail, and call up all their terrors to intimidate their aggressors; but seem to consider their teeth as unnecessary instruments of defence, and never attempt to use them. Even among the largest of this kind the teeth are never employed, in the most desperate engagements. When a hare or a bird is caught, the teeth may serve to prevent such small game from escaping; but when a buffalo or a tiger is to be encountered, it is by the strong folds of the body, by the fierce verberations of the tail, that the enemy is destroyed: by thus twining round, and drawing the knot with convulsive energy, this enormous reptile breaks every bone in the animal's body, and then, at one morsel, devours its prey.

From hence we may distinguish the unvenomous tribe into two kinds: first, into those that are seldom found of any considerable magnitude, and that never offend animals larger or more powerful than themselves, but which find their chief protection in flight, or in the doubtfulness of their form; secondly, into such as grow to an enormous size, fear no enemy, but indiscriminately attack all other animals and devour them. Of the first kind is the Common Black Snake, the Blind Worm, the Esculapian Serpent, the Amphisbæna, and several others. Of the second, the Liboya, the Boiguacu, the Depona, and the Boiquatrara.

The *Black Snake* is the largest of English



serpents, sometimes exceeding four feet in length. The neck is slender; the middle of the body thick; the back and sides covered with small scales; the belly with oblong, narrow, transverse plaits; the colour of the back and sides are of a dusky brown; the middle of the back marked with two rows of small black spots, running from the head to the tail; the plaits on the belly are dusky; the scales on the sides are of a bluish white; the teeth are small and serrated, lying on each side of the jaws in two rows. The whole species is perfectly inoffensive; taking shelter in dunghills,

and held it as you would hold a shield for defence. The snake instantly turned and came on at me with his head about a yard from the ground, as if to ask me what business I had to take liberties with his tail. I let him come, hissing and open-mouthed, within two feet of my face, and then, with all the force I was master of, I drove my fist, shielded by my hat, full in his jaws. He was stunned and confounded by the blow, and ere he could recover himself, I had seized his throat with both hands in such a position that he could not bite me; I then allowed him to coil himself round my body, and marched off with him as my lawful prize. He pressed me hard, but not alarmingly so."—*Waterton's Wanderings.*

and among bushes in moist places; from whence they seldom remove, unless in the midst of the day in summer; when they are called out by the heat to bask themselves in the sun. If disturbed or attacked, they move away among the brambles with great swiftness; but if too closely pursued, they hiss and threaten, and thus render themselves formidable, though incapable of offending.[1]

The black snake preys upon frogs, insects, worms, mice, and young birds: and, considering the smallness of the neck, it is amazing how large an animal it will swallow. The black snake of Virginia, which is larger than ours, and generally grows to six feet long, takes a prey proportionable to its size; partridges, chickens, and young ducks. It is generally found in the neighbourhood of the henroost, and will devour the eggs even while the hen is sitting upon them: these it swallows whole; and often, after it has done the mischief, will coil itself round in the nest.

The whole of this tribe are oviparous, excluding eighty or a hundred eggs at a time, which are laid in dunghills or hot-beds; the heat of which, aided by that of the sun, brings them to maturity. During winter they lie torpid, in banks or hedges, and under old trees.

The *Blind Worm* is another harmless reptile, with a formidable appearance. The usual length of this species is eleven inches. The eyes are red; the head small; the neck still more slender; from that part the body grows suddenly, and continues of an equal bulk to the tail, which ends quite blunt: the colour of the back is cinereous, marked with very small lines, composed of minute black specks; the sides are of a reddish cast; the belly dusky, and marked like the back. The motion of this serpent is slow; from which, and from the smallness of the eyes, are derived its names; some calling it the slow, and some the blind worm. Like all the rest of the kind in our climates, they lie torpid during winter; and are sometimes found in vast numbers, twisted together. This animal, like the former, is perfectly innocent; however, like the viper, it brings forth its young alive. Gesner tells us, that one of these being struck on the forehead when it was pregnant, it immediately cast forth its young.



The Amphisbæna, or the Double Headed Serpent, is remarkable for moving along with either the head, or the tail foremost; and from thence it has been thought to have two heads.[2] This error took its rise from the thickness of the tail, which, at a distance, may be mistaken for another head. Upon a nearer view, however, the error is easily discovered, and the animal will be found formed according to the usual course of nature. It is as thick at one end as at the other; and the colour of the skin is like that of the earth, being rough, hard, and variously spotted. Some have affirmed that its bite is dangerous; but this must be a mistake, as it wants the fangs, and, consequently, the elaboratory that prepares the poison.

These animals are only formidable from their similitude to the viper tribe. In some

[1] This snake, though not poisonous, is sometimes bold enough to attack a man, but may be driven off by a smart stroke from a stick, or whatever weapon he may chance to have in his hand. When it overtakes a person who has endeavoured to escape, (not having had courage enough to oppose it,) it is said to wind itself round his legs in such a manner as to throw him down, and then to bite him several times in the leg, or whatever it can lay hold of, and run off again.

The black snake is very greedy of milk, and it is difficult to keep it out when once it is accustomed to get into a cellar where milk is kept. It has been seen taking milk out of the same dish with the children without biting them, though they often gave it blows with their spoons upon the head when it was too greedy.

These snakes are, however, found extremely useful in America in clearing houses of rats, which they pursue with wonderful agility, even to the very roofs of barns and out-houses; for which good services they are cherished by the generality of the Americans, who are at great pains to preserve and multiply the breed.

There are many species and varieties of this genus of serpents, which it would be tedious to enumerate.

[2] *Amphisbæna* literally signifies *double-walker*, and was applied to these animals because they can move both backwards and forwards. The amphisbænæ of modern naturalists all belong to America, and must therefore be different from the amphisbænæ of the ancients. They are not venomous. The *White Amphisbæna* is common in Brazil, and feeds chiefly on ants. Its length is about a foot and a half. All the amphisbænæ which are varied with brown and white are known under the name of *fuliginosa*. The following cut represents a *Punctated Amphisbæna*.



The tail of an amphisbæna is almost as bulky as the head; and as the eyes are extremely small, it is difficult at first sight to say at which end the head is situated.

countries, where such reptiles are common, they make the distinction so exactly, that, while they destroy serpents of one kind with great animosity, they take others into their houses, and even into their bosoms, with a kind of unaccountable affection. The Esculapian Serpent of Italy is among this number. It is there suffered to crawl about the chambers; and often gets into the beds where people lie. It is a yellow serpent, of about an ell long; and though innocent, yet will bite when exasperated. They are said to be great destroyers of mice; and this may be the reason why they are taken under human protection. The Boyuna of Ceylon is equally a favourite among the natives; and they consider the meeting it as a sign of good luck. The Surinam Serpent, which some improperly call the Ammodytes, is equally harmless and desirable among the savages of that part of the world. They consider themselves as extremely happy if this animal comes into their huts. The colours of this serpent are so many and beautiful, that they surpass all description; and these, perhaps, are the chief inducements to the savages to consider its visits as so very fortunate. A still greater favourite is the Prince of Serpents, a native of Japan, that has not its equal for beauty. The scales which cover the back are reddish, finely shaded, and marbled with large spots of irregular figures mixed with black. The fore part of the head is covered with large beautiful scales; the jaws bordered with yellow; the forehead marked with a black marbled streak; and the eyes handsome and lively. But, of all others, the Gerenda of the East Indies is the most honoured and esteemed. To this animal, which is finely spotted with various colours, the natives of Calicut pay divine honours; and while their deity lies coiled up, which is its usual posture, the people fall upon their faces before it with stupid adoration. The African Gerenda is larger, and worshipped in the same manner by the inhabitants of the coasts of Mosambique. The skin is not so finely spotted as the former; but it is variegated all over the body with very fine white, ash-coloured, and black spots. The brilliancy of colouring in these reptiles would only serve with us to increase our disgust; but in those countries where they are common, distinctions are made; and even in this horrid class there are some eyes that can discover beauty.

But in the larger tribe of serpents, there is nothing but danger to be apprehended. This formidable class, though without venom, have something frightful in their colour, as well as their size and form. They want that vivid hue with which the savages are so much pleased in the lesser kinds; they are all found of a dusky colour, with large teeth, which are more formidable than dangerous.

The first of this class is the great Liboya of Java and Brazil, which Legaut affirms, he has seen fifty feet long.[1] Nor is he singular

[1] The *Boa Constrictor*.—This is the largest of the serpent race, reaching generally to thirty feet in length. Its ground colour is yellowish gray, on which is distributed, along the back, a series of large, chine-like, reddish brown, and sometimes perfectly red variegations, with other smaller and more irregular marks and spots. They are readily distinguished from other serpents in the under surface of the tail, being covered with scuta or divided plates, like those on their belly, and in their body not being terminated by a rattle. There are three species, natives of Africa, India, the larger Indian islands, and South America, where they chiefly reside in most retired situations in woods and marshy retreats. In those cases where the boa attacks a large quadruped, such as an antelope, he entwines himself round his prey, and by his great muscular power crushes the principal bones, so that the dimensions of the victim are considerably reduced, and after a series of efforts which sometimes approach to strangulation, the monster makes an end of his meal. There are stories of the boa constrictor destroying even the buffalo and the tiger, by crushing them in this manner by the astonishing force of its muscles. We shall confine ourselves at present to a well-authenticated account of the voracious appetite of a serpent of this species, which was brought from Batavia, in the year 1817, on board a vessel which conveyed Lord Amherst and his suite to England. This serpent was of large dimensions, though not of the very largest. A living goat was placed in his cage. He viewed his prey for a few seconds, felt it with his tongue, and then, withdrawing his head, darted at the throat. But the goat, displaying a courage worthy of a better fate, received the monster on his horns. The serpent retreated, to return to the combat with more deadly certainty. He seized the goat by the leg, pulled it violently down, and twisted himself with astonishing rapidity round the body, throwing his principal weight upon the neck. The goat was so overpowered that he could not even struggle for escape. For some minutes after his victim was dead the serpent did not change his posture. At length he gradually slackened his grasp, and having entirely disengaged himself, he prepared to swallow the lifeless body. Feeling it about with his mouth, he began to draw the head into his throat; but the horns, which were four inches in length, rendered the gorging of the head a difficult task. In about two hours the whole body had disappeared. During the continuance of this extraordinary exertion the appearance of the serpent was hideous; he seemed to be suffering strangulation; his cheeks looked as if they were bursting; and the horns appeared ready to protrude through the monster's scales. After he had accomplished his task, the boa measured double his ordinary diameter. He did not move from his posture for several days, and no irritation could rouse him from his torpor.

The *Anaconda* is a name which, like that of the Boa Constrictor, has been popularly applied to all the larger and more powerful snakes. It appears to be of Ceylonese origin, and may therefore belong of right, as well as of usage, to the Indian species.

Happily the appetite of these gigantic snakes bears no proportion to their means of gratifying it, as a full meal is uniformly succeeded by a state of torpor, which frequently lasts for a month or six weeks, or, during the cold season, even for a longer period.

The term *Python* is bestowed on a genus approximating to the *Boa*, and which Cuvier conceives to contain all the pretended Boas of the ancient continent. Among

in this report, as many of the missionaries affirm the same; and we have the concurrent testimony of historians as a further proof. The largest animal of this kind which has been brought into Europe, is but thirty-six feet long; and it is probable that much greater have been seen and destroyed before they were thought worth sending so far to satisfy European curiosity. The most usual length, however, of the Liboya, is about twenty feet, and the thickness in proportion. The teeth are small in proportion to the body; nor are they used but when it seizes the smallest prey. It lies in wait for wild animals near the paths, and when it throws itself upon them, it wraps them round so closely as to break all the bones; then moistening the whole body over with its slaver, it makes it fit for deglutition, and swallows it whole.

The Boiguaca is supposed to be the next in magnitude, and has often been seen to swallow a goat whole. It is thickest in the middle of the body, and grows shorter and smaller towards the head and the tail: on the middle of the back there is a chain of small black spots running along the length of it; and on each side there are large, round, black spots, at some distance from each other, which are white in the centre; between these, near the belly, there are two rows of lesser black spots, which run parallel to the back. It has a double row of sharp teeth in each jaw, of a white colour, and shining like mother-of-pearl. The head is broad; and over the eyes it is raised into two prominences; near the extremity of the tail there are two claws, resembling those of birds.

These serpents lie hid in thickets, from whence they sally out unawares, and, raising themselves upright on their tails, will attack both men and beasts. They make a loud hissing noise when exasperated; and sometimes winding up trees, will dart down upon travellers, and twist themselves so closely round their bodies, as to despatch them in a very few minutes. Condamine, however, affirms that their bite is not dangerous; for though the teeth are so large as to inspire the beholder with terror, yet the wound they make is attended with no dangerous consequences whatever. Dellon affirms, that they generally haunt desert places; and though they are sometimes seen near great towns, or on the banks of rivers, yet it is generally after some great inundation: he never saw any but what were dead; and they appeared to him like the trunk of a great tree lying on the ground.

To this class of large serpents we may refer the Depona, a native of Mexico, with a very large head and great jaws. The mouth is armed with cutting crooked teeth, among which there are two longer than the rest, placed in the fore part of the upper jaw, but very different from the fangs of the viper. All round the mouth there is a broad scaly border; and the eyes are so large, that they give it a very terrible aspect. The forehead is covered with very large scales; on which are placed others that are smaller, curiously ranged: those on the back are grayish, and along it runs a double chain, whose ends are joined in the manner of a buckler. Each side of the belly is marbled with large square spots, of a chestnut colour, in the middle of which is a spot which is round and yellow. They avoid the sight of man; and, consequently, never do much harm.

Such are the most noted animals of the serpent tribe; but to recount all, would be a vain, as well as useless, endeavour. In those countries where they abound, their discriminations are so numerous, and their colours so various, that every thicket seems to produce a new animal. The same serpent is often found to bring forth animals of eight or ten different colours; and the naturalist who attempts to arrange them by that mark, will find that he has made distinctions which are entirely disowned by Nature: however, a very con-

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the species of this genus is the Javan snake, which is as large as any boa. It inhabits the rice fields of Java, and feeds usually on birds, rats, &c. Its bite is not venomous. The following cut represents a Python, called



Peron's Python.

The *Bungai*, like the boa, have simple plates under the belly and under the tail. They inhabit the East Indies, where they are called Rock-Serpents. Their length is about seven feet. The following cut represents



a *Banded Bungarum.*

The *Hydras* have the posterior part of the body and tail very much compressed, and greatly raised in the verticle direction, which, giving them the faculty of swimming, constitutes them aquatic animals. They are



common in some latitudes of the Indian seas. The above is a figure of the *Spiral Hydra.*

siderable number might be added to enlarge the catalogue; but having supplied a general history, the mind turns away from a subject, where every object presents something formidable or lothesome to the imagination. Indeed, the whole tribe resemble each other so nearly, that the history of one may almost serve for every other. They are all terrible to the imagination, all frightful to behold in their fury, and have long been considered as a race of animals, between whom and man there is a natural antipathy.[1]

[1] *Supplemental Note on Reptiles.*—This department of animated beings, forming the third class of vertebrate animals, according to the arrangement of Cuvier, has occupied various situations in the classification of authors. Many of this species were known to the ancients. Pliny, in his *Historia Naturalis*, has given all the information, respecting those that were known during his time, which was, however, extremely limited, in comparison to what is our present stock of knowledge. The first of the moderns who increased our knowledge respecting the *Reptilia* was Aldrovandus, a Bohemian nobleman, and a professor of the university of Bologna: he published the first volume of his Natural History in folio, in the 1599, which was continued by his successors, and completed in fourteen volumes, in the year 1640. Gesner, a physician of Zurich, was the next who took up this subject; he published a work entitled a History of Animals, in three volumes folio, which appeared in 1620. To this work he added a treatise on Serpents. He was followed by Topsel, a British author, who published a History of Four-footed Beasts and Serpents in folio, 1718. These several works contain much curious information respecting reptiles, but so mixed up with fable, and the romance of travellers, that the accounts are not to be depended upon, and it is difficult to separate the pure matter from the dross. The animals of this class have in all ages furnished matter for fiction, from the dangerous qualities of many of the species, or the disgusting forms and frightful appearance of others. We are told that the march of the army of Attilius Regulus was arrested by the power of an African serpent, 120 feet long; and the Basilisk was said to possess the power of killing any person who looked at it, with a glance from its eyes.

But it was not until the publication of the *Synopsis Methodica Animalium, Quadrupedum et Serpentini generis*, in the year 1693, by Ray, that we had any distinct classification of reptiles which was worthy of attention. His arrangement consists of three orders; *first*, oviparous animals, with red blood, which respire by means of lungs, and which have a heart consisting of one ventricle. This order includes frogs, divided into aquatic and terrestrial, toads, and tortoises. *Second*, Lizards, and their congeners, including the saurians of Cuvier; and *third*, Serpents, or the ophidians of Cuvier.

The next systematic writer who followed Ray was Linnæus, who arranged this class of animals under the title of *Amphibia* in his *Systema Naturæ:* these he divided into three orders: namely, *Reptilia, Serpents,* and *Nantes,* which last most improperly included the cartilaginous fishes; these were removed to their proper station by Gmelin, who published an edition of the *Systema Naturæ*, with additions, in the year 1758. Linnæus was followed by Klein, who, in 1755, published his *Tentamen Erpetologiæ*, in which he arranged serpents into two orders; *first*, those whose heads are distinct from the body, with an elongated tail; and *second*, those with the head not distinctly developed from the body, and provided with an obtuse tail.

The next author was Laurentini, a physician of Vienna, who published his *Specimen Medicum exhibens Synopsin Reptilium emendatam*, in 1768, in which he divides them into three orders; namely, 1. *Leapers*, including frogs and their congeners; 2. *Walkers*, such as lizards; 3. *Serpents*. But this author entirely omitted tortoises in his classification.

The naturalist whose works are next worthy of notice, is Lacepede, who in 1798—1800, published his *Histoire Naturelle, Generale et Particulière des Quadrupedes ovipares et des Serpentes*, intended as a continuation of the *Histoire Naturelle* of Buffon. His classification differs but little from that of Linnæus, but contains a great mass of new and interesting matter, and he gives more accurate details, and more precise generic distinction than that author.

We now come to Brongniart, whose classification of reptiles far outstripped all those who preceded him. In 1799, he first made known his arrangements, which was published in 1805, under the title of *Essai d'une Classification Naturelle des Reptiles*. This has superseded all other arrangements, and has been followed by Cuvier in his *Regne Animal*. His orders are constructed upon their organization, such as generation and respiration, together with the exercise of the animal function, such as touch, digestion, and locomotion. Founded upon these, he divides the class Reptiles into four orders; viz. 1. *Chelonians*, in which the body is covered with a shield or plate, comprehending the turtles and tortoises. 2. *Saurians*, having the body covered with scales, including crocodiles, and their congeners. 3. *Ophidians*, destitute of feet, such as serpents. *Batrachians*, whose bodies are covered with a naked skin; exemplified in frogs, &c.

In the *Histoire Naturelle des Reptiles* of Latreille, published in Deterville's edition of the *Histoire Naturelle* of Buffon, as also in his *Familles Naturelles du Regne Animal*, published in 1825, he has attempted some trivial changes on the classification of Brongniart; retaining, however, all the principal features of his arrangement untouched.

Duméril, in his *Elemens des Sciences Naturelles*, has also made some changes; but these are unimportant.

Daudin published his *Histoire Naturelle des Reptiles*, in eight volumes 8vo., at Paris, in 1802, 1803. In this elaborate work much curious information is brought forward, and many particular facts, which were before unknown; but in his arrangement he has followed Brongniart, with some slight modification in the genera.

In the Linnæan Transactions and Zoological Journal are some interesting papers on Reptiles by Mr Thomas Bell. His monography of the tortoises having a movable sternum in the second volume of the Zoological Journal, and also his essay on *Leptophina*, a group of serpents, contain some valuable additions to our knowledge of reptiles.

The heart in reptiles is so constructed, that at each of its contractions, only a portion of the blood which it receives is transmitted to the lungs, the remainder of this fluid is returned to circulate again, without having passed into the lungs, and, consequently without having been subjected to respiration; hence it results that the action of oxygen on the blood is greatly less than in mammiferous animals and birds, where all the blood, by passing through their lungs, is exposed to the action of the air. Consequently, as respiration causes the heat in the blood, and gives to the muscular fibre its susceptibility for nervous irritation, the temperature of reptiles is much lower, and their muscular power greatly weaker than that of the mammalia, and birds. Therefore they are said to be cold blooded animals. Their general habits are also much less energetic, almost all their motions consisting of crawling and swimming, and although several species run or leap, at times with considerable facility, yet upon the whole, their actions are sluggish,

and their sensations obtuse, with a slow digestion ; and in temperate countries they pass the winter in an almost constant state of torpidity.

The brain in reptiles is proportionably small, and not so essential to the exercise of their animal and vital functions as to the mammalia and birds ; and their sensations appear to be referred to a common centre, for they continue to live, and exhibit voluntary motions long after being deprived of their brain, and in many instances after the head has been cut off. The connection of the nervous system with the muscular fibre is also less necessary to its contractions, and their muscles preserve their irritability after being severed from the body much longer than in the higher animals. The pulsations of the heart have been known to continue for many hours after being separated from the body; and even without it, the body will move for a considerable length of time. It has been observed that the cerebellum in several of the species is extremely small, which facts agree with their slight propensity to motion.

The smallness of the pulmonary vessels in reptiles enables them to suspend respiration without retarding the circulation of the blood ; this enables them to dive with more facility, and to remain longer under water than quadrupeds or birds. The cells of their lungs are also less numerous, and generally large, in consequence of their having fewer vessels to lodge on their parietes, and the lungs take sometimes the form of simple sacs, scarcely cellular in their structure.

The whole class are provided with a trachea and larynx, yet many of them are incapable of producing articulate sounds.

As their blood is cold, teguments for retaining heat are unnecessary, and instead of these, therefore, they are clothed with scales, or simply with a naked skin.

The females are provided with a double ovary and two oviducts, and the males of several genera are furnished with furcated organs of generation, but the batrachians are destitute of this organ. Those females which couple deposit eggs which are protected by a shelly covering, and those species which do not, produce soft and glary eggs, destitute of any crust. These they abandon after the deposition in some convenient situation ; but there are a few species which carry them about with them. The young is hatched perfect in its form in many species: but there are other species, which, on quitting the ova, have the organization of fishes, and whose form is not perfectly developed until after a certain time has elapsed, when they undergo a complete metamorphosis. This is well exemplified in the frog being hatched as a tadpole. These are provided with branchiæ, or gills, like fishes, and some of the genera retain these organs even after the developement of their lungs. In several of the oviparous reptiles, particularly in the coluber, the young animal in the egg is formed and considerably advanced at the moment it is deposited by the mother ; and there are even some species which may be artificially rendered viviparous, by simply retarding the time of laying the egg, which M. Geoffrey St Hilaire has proved by depriving the colubra of water.

The quantity of respiration in reptiles is not fixed, as is the case with mammalia and birds, but varies with the proportions of the diameter of the pulmonary artery, compared to that of the aorta. Tortoises and lizards, for example, respire much more than frogs, &c. ; and hence results a much greater difference of sensibility and nervous energy than can exist between one mammiferous animal and another, or between birds.

A greater variety of form prevails amongst reptiles than is found among the mammalia and birds, and it is in the production of these forms that Nature seems to have imagined shapes of the most fantastic description, and modifying in every possible manner the general plan which she has prescribed to herself in the vertebrata, and in the oviparous class in particular.

Reptiles are endowed with five senses, but none of them in great perfection. In those species which are covered with scales or plates, the sense of touch is very obtuse ; and in the species which have a naked skin, such as the frog, it is also weak, in consequence of not being adherent to the body, but invelopes it like a bag. In the serpents, the eyes are immovable, and are destitute of eyelids ; and the eyes covered with a corneous substance ; in some genera, three eyelids are distinguishable, while others are destitute of sight. They have no cochlea, and only provided with a small bone under the tympanum. Their nostrils are small, and they appear to have a very weak sense of smell. They have no delicacy of taste, for almost all the species swallow their food entire, and those in which the tongue is soft and flexible, this organ serves chiefly as an instrument for the seizure of their food. None of them have true fleshy lips ; and some, such as the tortoises, are provided with a horny bill, like that of a parrot; others have teeth of various forms, which are not, however, formed for mastication, but to assist in holding their prey: various serpents have hollow fangs, which they can erect at pleasure, when they open their mouths to bite, and these fangs have apertures, from which they inject into the wounds made by them an active and deadly poison. The anal opening in serpents serves for rejected matters, as well as for organs of generation.

The physical construction of reptiles varies considerably in the different orders ; deviating in several essential particulars, to which no general characters will apply. The following is an outline of these particulars.

I. The *Chelonia*, or *Tortoises*, have a heart with two auricles, and a ventricle, divided into two unequal cavities, which communicate with each other. The blood from the body is poured into the right auricle, and from the lungs into the left, but both kinds of blood are partially mixed in passing through the ventricle: their body is inveloped by two plates, or bucklers, formed by the ribs and sternum, supported by four feet. The envelope of the body permits no part to project, except the head, neck, tail, and four feet. The upper shield, which is called the *carpace*, is formed by the ribs, of which there are eight pairs; these are widened and reunited by denticulated sutures, and with plates adhering to the annular portion of the dorsal vertebræ, in such a manner, that all these parts are deprived of mobility. The lower shell, called the *plastron*, is formed of pieces, usually nine or ten in number, analogous to a sternum; and this has been denominated the *sternum* by the more recent writers on natural history. A frame work, consisting of bony pieces, which have been considered as analogous with the cartilaginous portion of the ribs in the mammalia, generally encompasses the upper shell, uniting all the ribs which comprise it. The vertebræ of the neck and tail are alone movable. These two bony envelopes being covered with skin or by scales, the scapula and all the muscles of the arms and neck, instead of being articulated to the ribs and spine, as in other animals, are attached beneath; the same arrangement is found in the bones of the pelvis, and also in all the muscles of the thigh, so that in this respect tortoises have been termed retroverted animals. The vertebral extremity of the scapula is articulated with the shield, and the opposite extremity of the clavicle with the breastplate or sternum, in such a manner, that the shoulders form a ring for the passage of the trachea and œsophagus. A third and larger bony branch, is directed downward and backwards, representing the coracoid apophysis in birds. The lungs are extensive, and situated in the same cavity with the other viscera. The thorax being immovable in the greater number, it is by the action of the mouth that the tortoise respires; this process being effected by keeping the jaws closed, and alternately raising and depressing the *os hyoides*. The first movement permits the air to enter by the nostrils, and the tongue afterwards closing the interior opening, the second movement forces the air into the lungs. Tortoises are devoid of teeth; their jaws are invested by a horny covering, similar to the mandibles of birds, ex-

cept in the Chelids, where they are covered with a skin only. Their tympanum and palatine arch are fixed to the cranium and immovable; the tongue is short and bristled with fleshy filaments; their stomach simple and strong; their intestines of medium length, and destitute of a cæcum. Tortoises lay numerous eggs, which are invested by a hard shell. These are deposited in the warm sand, under the influence of a southern sun, where they are abandoned by the parents, and are hatched in summer by the influence of the atmosphere. The animals of this order possess great tenacity of life, and they have been known to move for several weeks after amputation of the head. They require but little nourishment and can pass whole months, and even years, without food.

II. The *Sauria*, or *Lizards*, have a heart with two auricles, and a ventricle sometimes divided by imperfect partitions and their body covered by scales, supported by four or two feet. The ribs are movable, and partially attached to the sternum, and can be raised or depressed during respiration. The lung extends more or less towards the posterior part of the body; it frequently penetrates very far into the lower part of the abdomen, the transverse muscles of which pass under the ribs, and even towards the neck to clasp it. Those species in which this organ is very large, possess the singular faculty of changing the colours of their skin, according to the excitement produced on them by their wants or passions. Their mouth is invariably provided with teeth, and in most instances, their toes are armed with nails; their skin is covered with scales, more or less compact, and in a few species with scaly granules. All the species have a tail more or less long, which is very thick at the base. Most of them have four legs, but a few have only two. They subsist on animal food. Like the animals of the former order, they deposit their eggs favourably to their being hatched, where they abandon them; the young animal is hatched perfect in its form, and never undergoes any metamorphosis.

III. The *Ophidia*, or *Serpents*, have a heart with two auricles, and are destitute of feet, consequently they are the only order of this class, to which the name reptile is strictly applicable. Cuvier divides this order into three families. In the first, the terms *Anguines*, the teeth and tongue of which are similar to those of the genus Seps, of the preceding order, and the eye is provided with three eyelids. In the second family, or the true serpents, all the genera are destitute of a sternum or the slightest developement of collar bones; the ribs are articulated to each other by a convex and a concave surface, and encompass almost the entire circumference of the trunk. They are devoid of the third eyelid and tympanum. Although their heads are large, the true cranium forms but a small portion of it. Their eyes are fixed, but they are destitute of external ears. Their nostrils are short, and but slightly developed, and are generally situate at the extremity or sides of the muzzle. The Tongue varies much with the species; and although it is soft, moist, long, and forked, it seems rather destined to assist in seizing their prey, than as an organ of taste. The scaly covering with which they are invested, necessarily renders their sense of touch rather obtuse. They change their skin at least once a year. The third family embraces the Naked serpents, or those remarkable animals which form the genus *Cæcilia*. The whole animals of this order are provided with conical and curved teeth, which seem rather fitted for securing their prey, than for gnawing their food. Some of the genera are furnished with previous fangs in the superior jaw, which, when erected, press a gland or sac, in which is a deadly poison, which flows through the tube, and is injected into the wounds pierced by the fangs. In many species, the jaws are united in the middle, which renders the mouth susceptible of considerable dilatation, and enables them to swallow their prey entire. The process of digestion is extremely slow in all the animals of the order; and after feeding, they assume a lethargic condition, in which they continue frequently for weeks. Serpents possess a heart with two auricles and one ventricle, divided into two compartments, and they have only a single lung. Their circulation is slow. The only sound emitted by serpents is a hissing noise. The eggs are usually protected by a covering, or shell, which is somewhat calcareous; when laid, they are commonly united like a string of beads, or in the form of a wreath. Some species are, however, viviparous.

IV. The *Batrachia* are provided with a heart which has but one auricle, and a single ventricle; their body is naked; most of the species are metamorphosed from the form of a fish, breathing by the branchiæ, or gills, to that of a quadruped, breathing by lungs, when in a perfect condition. In two genera, however, namely, the *Serena* and *Proteus*, they retain the gills. In the former condition the aorta leading from the heart is branched into as many stems as there are gills. In those species, the branches which lead to the gills are all obliterated except two, which unite in a dorsal artery, give off each a small branch to the lung. This fact, as observed by Cuvier, is the circulation of a fish, changed into that of a reptile. All the Batrachian reptiles are destitute of scales, shields, or nails on their toes; the whole body and limbs being covered only by a naked skin. Their eggs have a membranous covering. In some species fecundation is performed during the extrusion of the eggs; in others they are deposited in some favourable situation, and afterwards impregnated in the same manner as the spawn of fishes.

ORDER I.—CHELONIA.

Heart provided with two auricles; body inveloped in two bony plates or shields, which are formed from the ribs and sternum; furnished with four feet.

Subdivision I.—Land Tortoises.

Testudo.
Testudo radiata, the Radiated Tortoise. Pl. 25, fig. 1.

Subdivision II.—Freshwater Tortoises.

Emys Europœa, European Emys.
Emys picta, the Painted Tortoise, pl. 25, fig. 2.
Cistuda.
Cistuda clausa, the Close Tortoise, pl. 25 fig. 3. Inhabits North America.
Chelonura Serpentina.

Subdivision III.—Sea Tortoises.

Chelonia.
Chelonia imbricata, the Hawk-billed Turtle. Pl. 25, f. 4. Inhabits the seas of the Torrid Zone.
Chelys fimbricata.
Trionyx feroœ.

ORDER II.—SAURIA.

Body elongated, invested with scales, generally furnished with four feet; toes armed with claws, at least in part; tail more or less long; mouth generally with numerous teeth.

Family I.—Crocodilidæ.

Body elongated, covered with square scales, of which the upper and under are the largest, and those above, raised into a ridge or corina in the middle; provided with four feet, with five toes before, and five behind, the three interior armed with nails, and all of them more or less united by membranes; each jaw provided with a single row of acute teeth; tongue fleshy, depressed, and almost entirely attached to the lower jaw; tail compressed, and provided above with a strongly dentated crest. The whole animals of this family are large, their bodies are covered with square, or oblong scales, of which those above form elevated lines, which are raised into a double crest on the tail. Their heads are long in proportion to the body, and ponderous; their jaws are articulated behind the cranium. Their nostrils form an elongated canal, which has its origin in the throat, and terminates at the point of the muzzle, where it is provided with a semilunar orifice, which it can open or shut at pleasure. Their eyes are furnished with three eyelids; the exterior ear is very small and can be closed at the will of the animal, by means of two fleshy coverings; under the throat there are two glands which secrete a musky substance, through small orifices. The crocodiles are the only family of this order which are destitute of clavicles, or collar bones; but their coracoid

apophysis is attached to the sternum, as in all the others.

Gaviala.

Gaviala Gangetica, the Gangetic Crocodile. Pl. 25, f. 6. Grows from twelve to eighteen feet in length. Inhabits the rivers of India, and is very numerous in the Ganges.

Crocodilus.

Crocodilus vulgaris, the Common Crocodile. Pl. 25, f. 5. This animal grows to the great size of from twenty to thirty feet in length.

Alligator.

Alligator sclerops, the Common Alligator. Pl. 25, f. 7. Grows from eighteen to twenty feet in length. Inhabits Guiana and Brazil. Crocodile's Egg, f. 12.

Family II.—Lacertinidæ.

The members of this family are characterised by a slender extensible tongue, terminating in two long filamentary processes like the viper. Their bodies are elongated, and their motions rapid. All their feet are provided with five toes, armed with nails, which are separate and unequal, particularly those on the hind feet. Under the abdomen and around the tail, their scales are disposed in traverse and parallel bands. Their tympanum is on a level with the head; the eyes are protected by a produced skin, which is longitudinally cleft, and which shuts by a sphincter. Under the anterior angle there is a rudimentary third eyelid. Their false ribs do not form a complete circle.

Monitor.

This genus is divided into sections. 1. With a compressed and carinated tail. 2. Tail nearly round, with a dentated ridge above. 3. Tail nearly round without a carinated ridge above. Of the last section is the land Monitor, which inhabits Egypt, and is trained by the jugglers of Cairo, to perform tricks, they having previously extracted their teeth.

Dracæna.

Dracæna Guianensis. Pl. 25, f. 10. Body reddish brown, blended with green. From four to six feet long. Inhabits Guiana. Its flesh is eaten by the natives. There are two sections of this genus, viz. 1. With a carinated tail. 2. With the tail smooth and compressed towards the point.

Teius. There are two sections of this genus. 1. Tail carinated. 2. Tail smooth; compressed towards the point.

Teius Teguixin, the Teguixin Lizard. Pl. 25, f. 15. Body black, spotted with blue above, and of a bluish hue below. Nearly six feet long. Inhabits Brazil.

Amevia.

Amevia lemniscata, the Striped Amevia. Pl. 25, f. 11. Inhabits Africa.

Lacerta.

Tachydromus.

Family III.—Iguanidæ.

Lizard shaped; with a thick, fleshy, and not extensible tongue, which is notched at the point.

Cordylus. Head simple.

Stellio. Head inflated behind.

Amblyrhynchus. Head short and truncated.

Agama. With a tumid head.

Agama muricata, the Muricated Agama. Pl. 25, f. 8.

Trapelus. Head tumid; scales small and destitute of spines. The only species of this genus is the Egyptian Trapelus, which has the property of changing the colour of its skin, in a still more remarkable degree than the cameleon.

Calotes. Upwards of a foot long. Inhabits New South Wales.

Lophyrus.

Basilicus.

Basilicus mitratus, the Mitred Basilisk. Pl. 25, f. 9. Inhabits Brazil. The flesh is eatable. There are only two species of this genus known, that above described, and the Aboyna Basilisk; they are disagreeable looking animals, but are entirely destitute of the deadly properties attributed by the ancients to the fabulous animal of that name.

Draco.

Draco lineatus, the Flying Dragon. Pl. 25, f. 16. Never exceeding nine or ten inches in length. Inhabits Asia and Africa.

Iguana.

Iguana vulgaris, the Common Guana. Pl. 25, f. 13.

Polychrus. Like the chameleon, the animals of this genus have the power of changing colour.

Anolius. There are two sections of this genus. 1. With the tail crested. 2. With the tail rounded.

Family IV.—Geckotidæ.

Gecko. Head considerably depressed; eyes large; tongue fleshy, but not extensible; jaws provided with a series of small close-set teeth, body flattened, covered above with small shagreen-like scales, and frequently tuberculate; below the scales are smaller, flat, and imbricated; tail with circular folds; toes widened their whole length, or at the extremity only, with the skin plated or scaly. The animals of this genus have the power of ascending perpendicular walls, and they can even walk on ceilings. Cuvier divides the genus into the following subgenera:—

I. *Platydactyli.*
II. *Hemidactyli.*
III. *Thecadactyli.*
IV. *Ptyodactyli.*

Ptyodactyli caudiverbera, the Scalloped-tailed Gecko. Pl. 25, f. 14. Inhabits Arabia.

V. *Phyluri.* Animals similar in form to the Gecko.

Family V.—Chamæleonidæ.

Chamæleon. Tongue fleshy, cylindrical, and extremely extensible; teeth trilobed; eyes large, but nearly covered by a skin, and with separate movements; destitute of an external ear; occiput pyramidal; body compressed, back edged or carinated, the whole covered with small shagreen-like granules; all the feet furnished with five toes, which are divided into two sets: the one with three toes, and the other with two, each united to the nails by a membrane; tail round and prehensile.

Chamæleon vulgaris, the Common Chameleon. Pl. 25, f. 17. Twenty-two inches long, including the tail. Inhabits India and Africa.

Family VI.—Scincidæ.

Tongue not extensible; body covered with equal-sized imbricated scales; legs short.

Scincus.

Scincus occiduus, the Galley wasp. Pl. 25, f. 26. From twelve to eighteen inches in length. Inhabits Jamaica.

Seps.

Seps palustris, the Great Water Newt. Pl. 25, f. 18. Inhabits stagnant waters in Europe.

Bipes.

Bipes apus, the Apoidal Apus. Pl. 25, f. 27. Inhabits the shores of the Volga.

Cholcides.

Chirotes.

Order III.—Ophidia.

Body greatly cylindrical, elongated, generally covered with scales, and destitute of feet.

Family I.—Anguines.

With small teeth nearly of equal size; tongue uniformly notched; ribs more or less united, being a substitute for a sternum: eyes provided with three eyelids.

Ophisaurus.

Anguis.

Acontias.

Family II.—Serpentes.

The species of this family are very numerous, and are all destitute of a sternum and scapular bones, and want the third eyelid, and also the tympanum. Cuvier subdivides them. The first subdivision includes those which have the lower jaw supported by a tympanal bone articulated to the cranium; the two branches of this jaw fixed before, and those of the upper jaw to the cranium, and to an intermaxilliary bone; which

prevents their dilatation. The eyes are small; the body cylindrical and covered with scales; the tongue short; the trachea long; the heart situate far behind, and provided with a single lung only.

I.—JAWS NOT DILATABLE.

Amphisbæna.
Amphisbæna fuliginosa, the Shining Amphisbæna. Two feet long. Inhabits Ceylon. Pl. 25. f. 25.
Typhlops.

II.—JAWS DILATABLE.

(1.) *Body Cylindrical, with Short Tongue.*

Tortrix.

(2.) *Occiput more or less gibbous; Tongue Forked and Extensible.*

Boa.
Boa canina, the South American Boa. Pl. 25, f. 24. Inhabits South America. In this genus are included the largest serpents, some of which reach from thirty to forty feet in length.
Erix.
Erpeton.

(3.) *Shields under the tail ranged in pairs.*

Python.
Hurria.
Dipsas.
Coluber.
Dryinus.
Leptophis.
Acrochordus.

(4.) *Serpents provided with Poison Fangs.*

The teeth in this section are fewer in number in the exterior row, than in the preceding section; the first of those teeth is larger than the others, it is hollow and conducts the poison from the sac into the wound.
Pseudoboa.
Trimeresurus.
Hydrophis.
Pelamis.
Chersydrus.

(5.) *With isolated Fangs.*

Crotalus.
Crotalus horridus, the Common Rattlesnake. Pl. 25, f. 23. From four to six feet long. Inhabits America.
Scytalus.
Acanthophis.
Langaha.

(6.) *Abdomen with Transverse Plates, divided into two under the Tail.*

Trigonocephalus.
Plataurus.
Naia.
Elaps.
Cobra.
Vipera.

Family III.—Naked Serpents.

Cæcilia. Eyes extremely small; body cylindrical, skin naked, with longitudinle folds.

ORDER IV.—BATRACHIA.

Heart with one auricle; body covered with naked skin; lungs two, in the mature condition, but provided with branchiæ, like fishes, in their early state.
Rana.
Rana taurina, the Bull Frog. Pl. 25, f. 21. Inhabits North America.
Hyla.
Bufo.
Bufo fuscus, the Brown Toad. Pl. 25, f. 22. Inhabits Germany.
Pipa.
Salamandra.

This genus is divided into sections:

1. *Terrestial*—Tail rounded in the adult state.
2. *Aquatic*—Tail compressed.

Proteus.
Proteus anguinus, the Proteus. Pl. 25, f. 20. This is the only species of the genus, and has several remarkable peculiarities. Besides being furnished with lungs, it has three tufted branchiæ on each side, which it seems to retain through life. The skeleton is nearly allied to that of the salamander, but is provided with more numerous vertebræ; and the general form of the cranium is considerably different. It inhabits dark subterraneous streams, in Carniola; and is the only animal known to exist in such situations.
Siren. Provided with a short thick adherent tongue; having both persistant branchiæ and interior lungs; body elongated, cylindrical, and furnished with a compressed tail; it has two feet only, which are placed forwards on the body, each provided with four toes.
Siren lacertina, the Siren. Pl. 25, f. 19. From two to three feet long. Inhabits the marshes of South Carolina. There is but one species of this remarkable genus: which, like the Proteus, retains during its life, three free branchial tufts, situate on each side of the neck, while it has at the same time lungs for breathing, formed in the ordinary manner.

HISTORY OF INSECTS, &c.

BOOK I.

INSECTS OF THE FIRST ORDER.

CHAP. I.

OF INSECTS IN GENERAL.[1]

HAVING gone through the upper ranks of Nature, we descend to that of insects; a subject almost inexhaustible, from the number of its tribes, and the variety of their appearance. Those who have professedly written on this subject, seem to consider it as one of the greatest that can occupy the human mind, as the most pleasing in animated nature.—"After

[1] *Insects.*—The following is Blummenbach's description of Insects. We have already given his account of Birds and of Fishes.

Insects (he says) derive their name from the circumstance, that, at least in the perfect state, the head, thorax, and abdomen are separated from one another, as though by incisions, nay, in many cases, seem as though connected only by a thread. Besides this, however, they are distinguished, with a few exceptions among the Genera of the Apterous Order, by peculiar and often very sensible organs, which, in the perfect state, are affixed to the head, (*Antennæ* or *feelers*,) which are always articulated at the root and, in addition, often formed into several joints; and lastly, by their horny, jointed legs, the number being always greater than in other animals; in perfect insects at least six, and in many instances, as many as one hundred and fifty, &c.

These characters excepted, insects, in general, have but little in their external appearance that is common to all. The almost incalculable number of species, the endless variety of offices they are destined to perform, and the consequent difference of their modes of life, wants, &c. require an extreme diversity in their forms, in which respect, as well as in the inequality of their sizes, we find remarkable contrasts.

Even their external coverings are much more diversified than is the case among other animals. Many are protected by a horny coat, composed of several portions, moving on one another like the pieces of a gauntlet, which serve to secure them from the effects of various accidents, and to compensate the deficiency of bones, which in other animals afford attachment to muscles, &c. Many are covered with fine hairs, and in butterflies, &c. the wings with little feathers or rather scales, which are occasionally of most beautiful colours: indeed, I may remark, that many animals of undescribable beauty are included in this class.

Insects also differ materially from other animals, with regard to the disposition of their organs of sense, and, probably, their mode of sensation, insomuch that, many naturalists have refused them certain of our external senses, as hearing and smell; but without justice, as the former clearly exists in many which emit certain sounds, as an enticement at the time of breeding, and the latter in a still greater number, which are capable of smelling out their food, though hidden.

The eyes of insects are particularly remarkable, and with respect to their structure, are of two kinds. The first are large hemispheres, mostly composed of thousands of facets, but in some instances, of numerous conical points, and covered on the inner surface with a layer sometimes glittering, sometimes variegated. Such are found in most winged insects, but also in many Aptera, as the lobster, &c. Those of the second kind (stemmata, ocelli,) are simple, small, and vary as well in number as position. Eyes of the first kind seem calculated for seeing at a distance; of the second, for looking at near objects; at least it may be supposed so, as we find that butterflies, in their winged perfect state, have such large, compound, telescopic eyes, whilst as caterpillars, they have small myopic ones. Only a few insects, crabs, for instance, can move their eyes.

The Antennæ (feelers) which vary much in different species, in many instances even according to the sex, and which many naturalists have supposed to be organs of smell, taste, &c., seem to be nothing more than their name implies—organs of feeling, probes, which are of great importance to insects on account of their hard, insensible covering, and the immobility of their eyes in most instances. They appear to possess their most acute feeling in the Antennæ, as man has in the tips of the fingers; and as for the most part they live in darkness, supply the want of light by this contrivance. On the other hand, the purposes of the *Palpi*, placed near the organs of mastication, found in almost all insects, and considered by some naturalists to be organs of sense, are as yet undetermined.

In their internal structure also, insects differ materially from red-blooded animals.—For instance, what has been considered as a heart in caterpillars, is a long canal of unequal width, placed along the back, but without any vessel arising from it; consequently, the nutrition of these insects must be effected in a peculiar manner, totally different from that of red-blooded animals. On

an attentive examination," says Swammerdam, "of the nature and anatomy of the smallest as well as the largest animals, I cannot help allowing the least an equal, or, perhaps, a superior degree of dignity. If, while we dissect with care the largest animals, we are filled with wonder at the elegant disposition of their parts; to what a height is our

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the other hand, they are provided with an incalculable number of air-vessels of an astonishingly delicate structure, and with numerous muscles, differing, however, as well in form as in colour, from those of red-blooded animals.

Although insects stand in need of the exchange of carbon of oxygen to effect the continuance for life, there are but few, as crabs, grasshoppers, many cicadæ and chafers, in which a motion resembling respiration can be observed. Insects in general breathe, not by the mouth, but by many *spiracula**. The greater number of them can live in a vacuum much longer than red-blooded animals, and many in mephitic atmospheres so fatal to others, and in which animal and vegetable substances become putrid, as carburetted hydrogen gas, &c.

The abode of insects on and under the surface of the earth, is much less limited than that of the other classes of animals. They are found on almost all warm-blooded animals, and even the larger insects, as bees, chafers, &c., are infested by peculiar kinds of lice. There are but few plants, also, (such as perhaps, the yew, savine, and most tree-mosses,) which do not serve for the abode and support of known insects. Many again, as the oak, are frequented and inhabited by more than a hundred distinct species. Generally, however, as insects are diffused over the earth, the residence of individual species is not less frequently limited to a very small number of animals and plants, or even particular parts of them.

Only a few insects live in a social state, affording mutual assistance in their labours. The greater number follow their pursuits singly: many, as spiders, live in society when young, but afterwards separate and live in a state of solitude, seeing creatures of the same species only at the time of pairing.

The remarkable edifices and habitations, which so many insects are capable of executing, have been already mentioned in speaking of instinct. There are but few creatures of this class which do not, at least once in their life, give proofs of this natural power of construction; either, as the cloth-moth and water-moth, form a habitation in their complete and larva state; or, like others, spin and prepare a receptacle to contain them during their metamorphosis and death-like sleep; or like the lion-ant, dig pits; and like the spider, weave webs for their prey; or like many species of the genus *Dyticus*, and some spiders, form bags or nets for the security of their posterity, and in which they deposit their eggs. Many of those which live in communities, build common residences, by their united powers, and under the guidance of an extremely regular, geometrical, innate instinct.

As to the kind of nourishment in insects, it is easy to see that it is not, as in most red-blooded animals, calculated merely for the preservation of the individual, but more particularly for the purpose of *consuming* organized matter. Insects must eat, not solely to satisfy hunger, but also to destroy carrion, to annihilate other insects, to extirpate weeds, &c.—An admirable provision, to the execution of which, besides the almost incalculable number of species, the extremely rapid multiplication of many, the unexampled voracity of others, and the quickness with which digestion is carried on in their very short intestinal canal, all tend to contribute. Thus it is known that a caterpillar will in twenty-four hours consume more than three times its own weight.—The organs of mastication in insects are more diversified than in any other class of animals: many are provided with jaws, having teeth and moving laterally; others, with a horny, pointed snout, (*rostrum*) for boring; others with a fleshy snout having a wide opening, (*proboscis*); and others with a tongue, so called, rolled into a spiral shape.

Some insects are secured from the attacks of their enemies by their deceptive form; others by having the same colour as the plants on which they live, and consequently being less readily noticed; others, by the powerful smell which they can diffuse in case of necessity; others by their social mode of life; others again by their astonishing strength, &c. Many are provided with weapons, as horns like forceps or nippers, or with stings and venom.

In the mode of propagation of insects there are also many peculiarities. Thus the two sexes in one and the same species are often so extremely different in form that they seem like animals of distinct kinds: in bees, and many similar insects, the greater number is without sex; that is to say, they are themselves produced without being destined in the ordinary course of nature for generation or impregnation.

This peculiarity extends in different insects to the mode of copulation. In not a few species, for instance, it is effected in flying, and many possess wings only during the short season of breeding. In general, the greater number live in a state of compulsory monogamy, inasmuch as they are incapable of copulating more than once in the course of life: death is with them so inevitable a result of their first copulation, that life may be prolonged by delaying the period of sexual connection.

Among other peculiarities of the business of propagation in insects, many, as the cochineal-worm, the land-flea, become of an enormous size during pregnancy: thus, in the white ant, it has been calculated that the abdomen of the female, when about to lay her eggs, is 2000 times larger than previous to impregnation.

Most insects lay eggs, which the mother, by a truly wonderful instinct, always deposits precisely in the situations best adapted for the future progeny. Many, for instance, lay their eggs in the bodies of living insects of other kinds, as in caterpillars, pupæ, &c.; or even in the eggs of other kinds of insects. The eggs of insects are occasionally, particularly among butterflies, of very various and remarkable form and appearance, and when deposited by the mother in the open air, are covered with a kind of varnish, protecting them from the destructive influence of rain and other accidents. Some few insects are viviparous, and many, as the plant-lice (Aphides), propagate in both ways.

A very remarkable phenomenon, almost confined to this class of animals, or at least much less striking in the others, is their metamorphosis. There is not any winged insect which escapes from the egg as such, but all, as well as many insects which have not wings, must first undergo a kind of change at certain periods of their existence. By this, not only their external form, but also at the same time their internal structure, contrary to common opinion, is altered in a certain degree, a circumstance which by no means coincides with the supposed pre-existence of pre-formed germs.

If the moth existed already formed in the caterpillar, we should at least expect that similar moths should be produced by similar caterpillars. But many American caterpillars, which resemble European ones in the closest manner posible, give origin to moths having totally dif-

* On the other hand, this class, in proportion to its vast number of species, contains but few aquatic animals: and of these, but very few exist in the ocean, which forms the abode of by far the greater number of species in the preceding and succeeding classes.

astonishment raised, when we discover all these parts arranged in the least in the same regular manner! Notwithstanding the smallness of ants, nothing hinders our preferring them to the largest animals; if we consider either their unwearied diligence, their wonderful strength, or their inimitable propensity to labour. Their amazing love to their young is still more unparalleled among the larger classes. They not only daily carry them to such places as may afford them food; but if, by accident, they are killed, and even cut into pieces, they, with the utmost tenderness, will carry them away, piecemeal, in their arms. Who can show such an example among the larger animals, which are dignified with the title of perfect? Who can find an instance in any other creature, that can come in competition with this?"

Such is the language of a man, who, by long study, become enamoured of this subject; but to those who judge less partially, it will be found that the insect tribe, for every reason, deserve but the last and lowest rank in animated nature. As in mechanics the most complicated machines are required to perform the nicest operations, so in anatomy the noblest animals are most variously and wonderfully made.—Of all living beings, man offers the most wonderful variety in his internal conformation; quadrupeds come next, and other animals follow in proportion to their powers or their excellencies. Insects seem, of all others, the most imperfectly formed: from their minuteness, the dissecting knife can go but a short way in the investigation; but one thing argues an evident imperfection, which is, that many of them can live a long time, though deprived of those organs which are necessary to life in the higher ranks of nature. Many of them are furnished with lungs and a heart, like nobler animals; yet the caterpillar continues to live, though its heart and lungs, which is often the case, are entirely eaten away.

But it is not from their conformation alone, that insects are inferior to other animals, but from their instincts also. It is true that the ant and the bee present us with very striking instances of assiduity; but how far are theirs beneath the mark of sagacity exhibited in the hound or the stag! A bee, taken from the swarm, is totally helpless and inactive, incapable of giving the smallest variation to its instincts: it has but one single method of operating, and, if put from that, it can turn to no other. In the pursuits of the hound, there is something like a choice; in the labours of

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ferent forms:—and on the other hand, many remarkably similar moths of both these parts of the world, are developed from caterpillars altogether unlike.

Insects which undergo metamorphosis are called *Larvæ*, whilst in the state in which they escape from the egg. They are mostly very small on their first appearance, so that a full grown caterpillar of the willow moth for instance, is 72,000 times heavier than when it issues from the egg. On the other hand, they grow with great rapidity, so that as an example, the maggot of the meat-fly, at the end of twenty-four hours, is 155 times heavier than at its birth. Some larvæ have feet, as caterpillars and the grubs of chafers; others have not, as maggots: none have wings. In this state also they are incapable of propagating; they merely feed, increase, and change their covering several times.

The form into which the larva is converted is called nympha. Many can move about and take food when in this state. Others, on the contrary, are covered up, as pupæ (chrysalis, Aurelia), and pass this portion of their life in a state of torpor without eating or moving.

During the time, however, that the creature thus lies insensible and torpid within its coverings, a great change is going forward, by which it quits the larva-state, and is enabled to leave its prison as a perfect insect (*Insectum declaratum, imago*). Many insects finish this last portion of their existence in a very short time. Several, when they break from the coverings of the larva-state are unprovided with a mouth, and cease to eat or grow. These two functions of all organized bodies they performed while *larvæ;* a third only remains—to propagate the species, and then to give way to their posterity and perish.

The immediate utility of insects to man, is but limited; but, on the other hand, the parts which these small and unnoticed animals perform in the general economy of nature, is in an equal degree varied and incalculable. Some destroy numerous kinds of weeds in the bud, or extirpate them when full grown. Another extremely useful object is effected by many insects which feed on carrion, live in dung, &c., and by that means destroy, disperse and change noxious animal substances; on the one hand, obviating the infection of the air, and on the other, promoting the fertilization of the earth. It is in this way, for instance, that flies are so serviceable in warm climates. So again, there are innumerable insects which effect the impregnation of plants in a very remarkable manner, as a species of *Cynips* is employed for the artificial fructifications of the fig. Various kinds of insects are used as baits for fishing. Many animals of this class, as crabs and some kinds of locusts, are eatable. So also is the honey of bees, from which mead is prepared in many parts of Europe and Africa. Silk is employed for clothing and many other purposes. Several insects afford excellent dyes, as cochineal, &c. Galls are employed for ink,—wax for lights, and other purposes. Lac, which is the product of certain Indian species of coccus, is employed to make varnish, sealing-wax, &c. As medicines, we have spanish flies, wood-lice, ants—the oil-beetle, recommended in hydrophobia, and many beetles for relieving toothache.

Great as is the utility of insects, the injury done by many is also very considerable. Many are noxious to the products of the earth in general, cause scarcity, or as locusts, destroy every thing in their course. Some are especially injurious to corn; others, as caterpillars, grubs, &c., to garden-plants, or fruit-trees; the various species of coccus, to orange-trees in particular; the larvæ of some species of dermestes, &c. to forest trees; ants, &c. to meadows; cock-roaches, to victuals; the white ants, &c. to furniture; moths to woollen goods, fur, &c.; the larvæ of many small insects, to books, collections of natural history, &c. Lastly, some kinds of vermin infest man, horses, sheep, fowls, other domestic animals, and even other serviceable insects, as bees, silk-worms. Others again, as scorpions, are formidable by their venom.

the bee, the whole appears like necessity or compulsion.

If insects be considered as bearing a relation to man, and as assisting him in the pleasures or necessities of life, they will, even in this respect, sink in the comparison with the larger tribes of nature. It is true that the bee, the silk-worm, the cochineal fly, and the cantharides, render him signal services; but how many others of this class are either noxious or totally unserviceable to him? Even in a country like ours, where all the noxious animals have been reduced by repeated assiduity, the insect tribes still maintain their ground, and are but too often unwelcome intruders upon the fruits of human industry. But in more uncultivated regions, their annoyance and devastations are terrible. What an uncomfortable life must the natives lead in Lapland, and some parts of America, where, if a candle be lighted, the insects swarm in such abundance, as instantly to extinguish it with their numbers; where the inhabitants are obliged to smear their bodies and faces with tar, or some other composition, to protect them from the puncture of their minute enemies; where, though millions are destroyed, famished millions are still seen to succeed, and to make the torture endless!

Their amazing number is also an argument of their imperfection. It is a rule that obtains through all nature, that the nobler animals are slowly produced, and that nature acts with a kind of dignified economy; but the meaner births are lavished in profusion, and thousands are brought forth merely to supply the necessities of the more favourite objects of creation. Of all other productions in nature, insects are the most numerous. Vegetables that cover the surface of the earth, bear no proportion to their multitudes; and though, at first sight, herbs of the field seem to be the parts of organized nature produced in the greatest abundance; yet, upon minuter inspection, we shall find every plant supporting a number of scarcely perceptible creatures, that fill up the various stages of youth, vigour, and age, in the compass of a few days' existence.

All other animals are capable of some degree of education; their instincts may be suppressed or altered: the dog may be taught to fetch and carry; the bird to whistle a tune; and the serpent to dance: but the insect has but one invariable method of operating; no arts can turn it from its instincts; and, indeed, its life is too short for instruction, as a single season often terminates its existence.

For these reasons, the insect tribe are deservedly placed in the lowest rank of animated nature; and, in general, they seem more allied to the vegetables on which they feed, than to the nobler classes above them. Many of them are attached to one vegetable, often to a single leaf; there they increase with the flourishing plant, and die as it decays; a few days fill up the measure of their contemptible lives; while the ends for which they were produced, or the pleasures they enjoyed, to us at least, are utterly unknown.

Yet while I am thus fixing the rank of a certain class of animals, it seems necessary to define the nature of those animals which are thus degraded. Definitions in general produce little knowledge; but here, where the shades of nature are so intimately blended, some discrimination is necessary to prevent confusion. The smallness of the animal, for instance, does not constitute an insect; for then, many of the lizard kind, which are not above two inches long, would come under this denomination; and if the smaller lizards, why not the crocodile? which would be a terrible insect indeed! In the same manner, smallness, with a slow creeping motion, does not constitute an insect; for, though snails might be called insects, with the same propriety the whole tribe of sea shell-fish would then have equal pretensions; and a very troublesome innovation would be brought into our language, which is already formed. Excluding such animals, therefore, from the insect tribe, we may define insects to be *little animals without red blood, bones, or cartilages, furnished with a trunk, or else a mouth, opening lengthwise, with eyes which they are incapable of covering, and with lungs which have their opening on the sides.* This definition comprehends the whole class of insects, whether with or without wings; whether in their caterpillar or butterfly state; whether produced in the ordinary method of generation between male and female, or from an animal that is itself both male and female, or from the same animal cut into several parts, and each part producing a perfect animal.

From hence it appears, that in this class of animals there are numerous distinctions, and that a general description will by no means serve for all. Almost every species has its own distinct history; and exhibits manners, appetites, and modes of propagation, peculiarly its own. In the larger ranks of existence, two animals that nearly resemble each other in form, will be found to have a similar history; but here insects almost entirely alike will be often found perfectly dissimilar, as well in their manner of bringing forth and subsisting, as in the changes which they undergo during their short lives. Thus, as this class is prolific beyond computation, so are its varieties multiplied beyond the power of description. The attempt to enumerate all the species of a fly or a moth would be very fruitless; but to give a history of all would be utterly impracticable: so various are the appetites, the manners, and the lives of this humble class of

beings, that every species requires its distinct history. An exact plan, therefore, of Nature's operations in this minute set of creatures, is not to be expected; and yet such a general picture may be given, as is sufficient to show the protection which Providence affords its smallest as well as its largest productions, and to display that admirable circulation in nature by which one set of living beings find subsistence from the destruction of another; and by which life is continued without a pause in every part of the creation.

Upon casting a slight view over the whole insect tribe, just when they are supposed to rouse from their state of annual torpidity, when they begin to feel the genial influence of spring, and again exhibit new life in every part of nature, their numbers and their varieties seem to exceed all powers of calculation, and they are indeed too great for description. When we look closer, however, we shall find some striking similitudes, either in their propagation, their manners, or their form, that give us a hint for grouping several of them into one description, and thus enabling us to shorten the labour of a separate history for every species. Swammerdam, Reaumur, and Linnæus, have each attempted to abridge the task of description, by throwing a number of similar animals into distinct classes, and thus making one general history stand for all. I will avail myself of their labours; and uniting their general distinctions, throw the whole class of insects into four separate distributions, giving under each the history of every species that seems to me considerable enough to deserve our notice. Thus our labour will be shortened; and the very rank in which an insect is placed, will, in some measure, exhibit a considerable part of its history.[1]

In our cursory inspection of the insect tribe, the first animals that offer themselves are those which want wings, that appear crawling about on every plant, and on every spot of earth we

[1] *Sketch of the History of Insects.*—The observation of this numerous, diversified, and interesting class of beings, and, consequently, the origin of entomological science, must necessarily have been coeval with the creation of man. About five hundred years before Christ Hippocrates wrote upon insects. Aristotle describes them as consisting of three parts—head, trunk and abdomen: he then speaks of what he calls *tribes* of insects, dividing them, from their mode of progression, into those that walk and those that fly, noticing and commenting on their wings, proboscis, antennæ, and feet, carefully observing the latter, and exhibiting in this, as in every other department of zoology, that accuracy which so eminently distinguished the philosophical preceptor of Alexander the Great. Pliny is the next author of any note whose attention seems to have been directed to the study in question, for, in his eleventh book, he speaks of various bees, wasps, &c. From this period, down to 1519, when the work of Albertus Magnus upon insects was published, the science made a silent but certain progress. Its advance in the succeeding thirty years is visible in the efficient attempt at a better system of classification than had hitherto prevailed, in the *De Animalibus Subterraneis* of the last mentioned author, in 1549. He there divides insects into three classes—those that walk, those that fly, and those that swim, describing several species of each class. In 1552, Wotton published his *De Differentiis Animalium*, and was followed by numerous writers on the subject of insects, whose books possessed more or less merit: some of them were illustrated with figures, and all tended to render the study more worthy of the name of a science. We may mention in particular the folio of the learned and liberal Aldrovandus, 1602, and Mouffet's *Insectorum Theatrum*. The *Experimenta*, &c. of Redi, 1671, also deserves especial attention for its triumphant refutation of the then popular error of equivocal generation—an error whose origin is buried in the remotest antiquity, upheld by the ancient philosophers, and not even yet eradicated from the minds of the common people. Redi demonstrated the fact, that every living animal is derived from an egg, deposited by a parent every way similar to itself.

Previous to this, in 1669, the great work of Swammerdam—*Historia Insectorum Generalis*—was given to the public, but was utterly neglected until the death of the author, in 1680, when it was instantly discovered to be of such value as to demand a translation. No bookseller could be found who would risk the expense of printing the *Biblia Naturæ*, a second work from the same pen, until it accidentally fell into the possession of the learned Boerhaave, who published it, together with the life of Swammerdam, in 1738. In that book, which is still considered as one of the most valuable we possess on the anatomy of insects, he divides them into the four following classes:—1. those whose characters are constant, undergoing no change whatever, and which preserve for life the form in which they leave the ovum; spiders, &c.: 2. those which, on their liberation from the ovum, have the appearance of an insect without wings, but otherwise completely formed, and that pass into the state of a nymph or chrysalis, from which they issue provided with wings, and fitted for continuing the species; dragon-flies, &c.: 3. those which, having existed in the ovum in a disguised form, leave it under the appearance of an insect (caterpillar), which feeds and increases in size, while the various parts of the new animal, into which it is to be converted, are forming under its skin, and finally becomes a nymph; moths, butterflies, &c.: 4. those which, having arrived at maturity, do not divest themselves of their skin, but pass into the chrysalis state under it, remaining there till the metamorphosis is completely effected, when, quitting both skins at once, they come forth in their final and perfect form; ichneumons, &c.

Malpighi and Vallisnieri also enriched the science with the results of their observations, in common with others of less note. The *Mémoires*, &c., of Perrault (Paris, 1671), Lister's book on spiders, the *Historia Animalium Angliæ*, &c., (1678), and those of Ferrand, Mollerus, and Berelio, all tended to the same result. In 1685, a Latin edition of the works of Goedart was published by Dr Lister, just named, a learned entomologist of that period, and physician to queen Anne, who gave a new arrangement to the materials collected by his industrious though not very acute author, who was more of a collector and painter of insects than a scientific observer. In that work, Lister establishes ten classes of Insects:—1. moths with erect wings, or diurnal butterflies; 2. moths with horizontal wings, the perfect insect of the caterpillar, called the *geometra* by Goedart; 3. moths with deflected wings; 4. libellulæ; 5. bees; 6. beetles; 7. grasshoppers; 8. dipterous flies; 9. millipedes; and, 10. spiders. There is nothing, however, in this mode of division, which merits any peculiar praise, or that should

regard with any degree of attention. Of these, some never obtain wings at any period of their existence: but are destined to creep on the vegetable, or the spot of earth, where they are stationed for their whole lives. On the contrary, others are only candidates for a more happy situation; and only wait their growing wings, when they may be said to arrive at their state of full perfection.

Those that never have wings, but creep

prevent us from passing immediately to the microscopical discoveries of the celebrated Leuwenhoeck, from whose inventive genius and patient observations the science received such essential benefit, not more by what he himself discovered, than by the foundation he laid for that system of close and minute observation which alone leads to truth. Our limits will only permit us to designate Blankaart and Geyerus, as occupying a similar rank with Goedart.

Ray, however, deserves more particular notice. His descriptions are very exact and detailed, and his various works, *Synopis Methodica Animalium*, &c., (Lond., 1783), *Synopsis Methodica Avium et Piscium*, (Lond., 1713), and the *Historia Insectorum* (Lond., 1710), sufficiently demonstrate his claim to the title of the first true systematist. His was the glory of serving as a zoological guide to the illustrious Swedish reformer, of whom we shall soon have to speak. Ray divides insects into two great classes—those which undergo a metamorphosis after having been produced, and those which do not. He again subdivides each of these classes into orders, characterized by the feet, or by their absence; by their habitations; by the size or conformation of the various parts of the body; by their larvæ, &c. In this arrangement were included certain tribes of *vermes*, subsequently separated by Linnæus. The voluminous productions, upon this subject, of the indefatigable Reaumur who directed his researches into every department of science, appeared in Paris in 6 vols., 4to., 1734.—1742. His *Mémoires pour servir á l' Histoire des Insects*—for such is its modest title—is an admirable work, both with respect to the number and value of the observations it contains. It is to be lamented that the 7th volume, which is completed, remains unpublished. The intended remaining ones were not commenced when Reaumur died, in 1757.

But a greater name than any we have yet mentioned is that of the illustrious reformer of the nomenclature of the natural sciences. Notwithstanding the labours of so many ingenious, learned and acute observers of nature, the history of animals, and that of insects in particular, remained in a confused state until the illustrious Linnæus reduced the chaotic pile to order. Directing all the energies of his clear and comprehensive mind to the subject, he produced, in his well known *Systema Naturæ*, 1735, the first truly methodical work. In a final edition of the same book, we find an arrangement of insects differing from that contained in the former; and, as that is the one always referred to at the present day, and as his divisions are, to a certain extent, still retained, we deem it proper to notice it here. He divides insects into *caleoptera*, *hemoptera*, *lepidoptera*, *neuroptera*, *hymenoptera*, *diptera*, and *aptera*. In this class were also included the *crustacea* and *arachnides*, now forming the first and second classes of the third great division of the animal kingdom, or the *animalia articulata*. The system of Linnæus, though not a natural one, was well adapted to the limited number of animals then known, and which, with respect to insects, did not exceed 800 or 900. Its subsequent alterations necessarily arose from the immense number of new ones which the increasing zeal of observers detected in every part of the globe.

L'Admiral, Letharding, Lesser, Degeer, Roesel, Scopoli, and Geoffroy, all contributed and some of them greatly, to multiply facts and detect errors. Lyonnet, however, merits something more than the bare mention of his name. Animated by a zeal that no disappointment could damp, and armed with a patience that set obstacles at defiance, this untiring inquirer devoted seven years of his life to the anatomy of a single insect—the larva of a species of *cossus* that inhabits the willow. The plates of his work, the *Traité Anatomique de la Chenille du Saule* (4to., 1762), eighteen in number, were all engraved by his own hand, with a minuteness, fidelity, and elegance that have seldom, if ever, been equalled. The *ensemble* is pronounced, by the greatest authority of our age, a *chef-d'œuvre* both of anatomy and engraving.

We cannot stop to notice particularly the labours of Schæffer, Seba, Forster, and Drury, each of whom added something to the general fund of knowledge. With respect to those of Fabricius, it is otherwise. This celebrated entomologist, and pupil of Linnæus, published numerous and valuable works on his favourite science, of which we will only cite the *Entomologia Systematica, emendata et aucta* (4 vols., 8vo., 1792—1794), the *Supplementum Entomologiæ Systematicæ* (1798), and the *Systema Eleutheratorum, Rhyngotorum*, &c., (from 1801 to 1805). He was the first who had recourse to the parts of the mouth, or organs of manducation, as a basis of distribution; and a vast number of new species of insects were described by him, in his remarkably concise but clear manner, with which Gmelin, a naturalist, or or rather editor, of a very different class, enriched the *Systema* of Linnæus. The splendid and costly works of Oliver (5 vols., fol., Paris, 1789—1808), Donovan (London, 1778—1805), Palisot de Beauvois, (Paris, fol., 1805, et seq.) Cramer, (4 vols., 4to, with 400 coloured plates, Amsterdam, 1779, continued by Stoll, in 1 vol., 4to., 1790 et seq.), together with a multitude of others of a less magnificent description, bring our sketch down to a period in the annals of the natural sciences which is graced by the name of Cuvier. It is to him that we are indebted for what is termed the *natural method*, or an arrangement in which, to use his own words, "all beings of the same genus are placed nearer to each other than to those of all other genera of the same order similarly disposed with respect to those of all other orders, &c." The energy and discrimination of this modern *oracle of the natural sciences*, as he has justly been styled, aided by untiring industry, have fixed the foundations of zoology upon the immutable basis of comparative anatomy. From the moment his *Table au élémentaire de l' Histoire naturelle des Animaux*, and his *Leçons d' Anatomie Comparée*, made their appearance, the entomologist, in common with the cultivators of every other branch of zoology, was sensible that he at last held the clew by which he could hope to traverse the hitherto impracticable labyrinth. The study now became a greater object of interest than ever. Lamarck produced his work upon invertebral animals, and Latreille, guided by Cuvier, soon gave to the world his famous entomological system.

Among the modern writers of eminence on the subject of insects, MacLeay, Leach, and Kirby stand pre-eminent in England. Prussia boasts of her Klug and Illiger; Germany of her Knoch, Mannerheim, and Germar; Russia of her Fischer; Sweden of her Paykull, Gyllenhal, and Schoenherr; and France, that favourite seat of science, gave birth to Latreille, the greatest of entomologists. There, too, count Dejean is busied with his admirable work on coleopterous insects, which, when completed, will leave nothing to be desired with respect to that order. Leon Dufour, of the same country, by his various memoirs on the anatomy of a new species of *brachinus*, on that of the *coleoptera*, of the *cicaderiæ*, of the *cicadella*, of the *forficulæ*, &c., has given ample

about till they die, may be considered as constituting the FIRST CLASS of insects. All these, the flea and the woodlouse only excepted, are produced from an egg; and when once they break the shell, they never suffer any further change of form, but continue to grow larger till they die. Thus the louse or the spider are produced from an egg, never suffering any al-

proofs of his devotion to the science, and of his title to the rank of the first entomological anatomist of the age. Savigny, also, who sacrificed his sight to his anatomical investigations, and was one of the *savants* who accompanied the expedition to Egypt, has rendered the most important services to this branch of zoology, by his work on the mouths of insects. In America, Melsheimer (who furnished Knoch with the greater part of his species), Say, Hentz, Le Conte, Harris, and many others, have successfully exerted themselves in detecting and describing the insects of the United States.

In the earlier writings of Lamarck, he included the Crustacea, as well as the Arachnides, in his Class Insecta. These have since been formed into separate Classes by him, but as the latter of these is so nearly allied to the true insects, we retain it at the head of that Class, under its own proper title.

ARACHNIDES.

The Arachnides are oviparous animals, provided with articulated members, but do not undergo a metamorphosis, similar to insects. They respire, either by bronchiæ or by means of a trachea, the openings for the admission of air being stigmatiform; and they are destitute of antennæ.

ORDER I.—PULMONARIÆ.

With a heart; each side of the abdomen with bronchial sacs; six to eight eyes; two pedipalpi; two jaws and palpi; and four pair of feet: sexual organs double.

SECTION I.—PEDIPALPI.

Very large palpi; abdomen distinctly annulated, having no web-spinning papillæ.

FAMILY I.—SCORPIONIDES.

With a sessile abdomen, provided with four spiracles, the six terminal segments forming a tail; the last one pointed, and serving as a sting, perforated for the passage of poison; palpi forceps-shaped. *Scorpio Afer*, pl. 26. f. 1.

FAMILY II.—TARANTULÆ.

With a pedunculated abdomen, each side below furnished with two spiracles, and terminated by a stingless, jointed filament; palpi arm-shaped, with spinous extremities; mandibles monodactyle; anterior feet longer than the others; tongue long and dart-shaped. *Thelyphonus Caudatus*, pl. 26. f. 2.

SECTION II.—ARANEIDES.

Palpi like small feet, ending in a hook; last joint bearing the sexual organs in the male; four or six mamillæ placed near the anal opening, in both sexes, for the purpose of spinning.

I.—TETRAPNEUMONES.

Provided with two spiracles, and two pulmonary sacs on both sides. *Mygale Cæmentaria*, pl. 26. f. 3.

II.—DIPNEUMONES.

Having only one spiracle, and one pulmonary sac, on each side; six spinning orifices: the four exterior quadrangular, and two smaller ones in the middle.

FAMILY I.—TUBITELÆ.

Spinning orifices fasciculated, approximated, and cylindrical; feet strong. *Aranea Domestica*, pl. 26, f. 4.

FAMILY II.—INÆQUITELLÆ.

Spinning papillæ converging and conical; feet very slender; first and last pairs are usually longer than the others; jaws inclined upon the labium. *Scytodes thoracica*, pl. 26, f. 5.

FAMILY III.—ORBITELÆ.

Differing from the preceding family, in the first and second pair of feet being usually longest; the jaws are straight, and wider above. *Epeira diadema*, pl. 26, f. 6.

FAMILY IV.—LATERIGRADÆ.

When in a state of repose the feet are horizontally extended, four anterior longest and nearly equal; eyes forming the segment of a circle in one division, and in two parallel lines in another. *Thomisus castaneus*, pl. 26, f. 7.

FAMILY V.—CITIGRADÆ.

Eyes, eight in number, placed curvilinearly triangular, or ovally truncated. They spin no webs; capture their prey by leaping. *Lycosa Tarantula*, pl. 26, f. 8.

FAMILY VI.—SALTIGRADÆ.

Legs formed for leaping; eyes either in a single or double quadrangular group, the smaller ones within the other. *Eresus moniligerus*, pl. 26, f. 9.

ORDER II.—TRACHEARIÆ.

Without a heart, but in its stead a single dorsal vessel; they respire through a radiated trachea, the air passing through spiracles in the abdomen or thorax; eyes from two to four; some are blind; mouth usually syphon-shaped; sexual organs single.

FAMILY I.—PYCNOGONIDES.

With a projecting syphon; four eyes placed on a single tubercle; feet mostly long, terminated by unequal hooks; at the base of the first are two oviferous feet. *Pycnogonon Balænarum*, pl. 26, f. 10.

FAMILY II.—PSEUDOSCORPIONES.

With very large, pediform palpi, with a didactyle hand or a vascular button. *Chelifer Cancroides*, pl. 26, f. 11.

FAMILY III.—PHALANGITA.

With slender filiform palpi, terminated by a hook. *Siro rubens*, pl. 26, f. 12.

FAMILY IV.—ACARIDES.

With an oval or globular extremely minute body; generally with two filiform palpi; eyes minute; eight hairy feet, each terminated with two or three hooks. *Trombidium tinctorum*, pl. 26, f. 13.

FAMILY V.—HYDRACHNELLÆ.

Mouth generally produced and feet adapted for swimming. *Hydrachna geographica*, pl. 26, f. 14.

FAMILY VI.—RICINIÆ.

Mouth produced, legs formed for walking, wandering, or parasitical land animals. *Argas reflexus*, pl. 26, f. 15.

FAMILY VII.—MICROPHTHIRA.

Having six legs, and always parasitical. *Leptus Autumnalis*. Pl. 26, f. 15.

INSECTS.

ORDER I.—THYSANOURA.

These are apterous insects, with six feet, and under-

teration when once they are excluded; but, like the chicken or the duck, remaining invariably the same, from their birth to their dissolution.

The SECOND ORDER of insects consists of such as have wings; but which, when produced from the egg, have those wings cased up in such a manner as not to appear. This casing

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go no metamorphosis; head distinct; two antennæ, which are longer than the head; abdomen with a terminal forked or filamentary tail.

FAMILY I.—LEPISMENÆ.

Antennæ with many small joints; palpi produced; abdomen provided with a series of movable appendages on each side. *Machilis polypoda*, pl. 28, f. 1.

FAMILY II.—PODURELLÆ.

Antennæ four jointed; mouth destitute of palpi; no lateral appendages on the abdomen; tail forked (used in leaping) while in repose it is folded under the abdomen. *Podura Plumbea*, pl. 28, f. 2.

ORDER II.—PARASITA.

With six feet; no abdominal appendages; two or four small eyes; exterior mouth, nipple or snout-shaped, inclosing a retractile sucker; sometimes having membranous lips, with doubly hooked mandibles.

FAMILY I.—MANDIBULATA.

Having two lips, mandibles, and jaws. *Ricinus corvicoracis*, pl. 28, f. 3.

FAMILY II.—SIPHUNCULATA.

No mandibles; mouth consisting of a beak, from which a sucker can be protruded at will. *Pediculus coturnicis*, pl. 28, f. 4.

ORDER III.—SYPHONAPTERA.

With a compressed body; mouth provided with a two-pieced sucker, inclosed between two articulated laminæ; these form a conical or cylindrical beak, covered with scales at the base. It consists of but one genus.

Pulex irritans, pl. 28, f. 5. With an oval compressed body, consisting of twelve segments; three of which compose the thorax, and the remaining the abdomen; six feet; beak, jointed, consisting of two plates inclosing a sucker.

ORDER IV.—COLEOPTERA.

Having four crustaceous elytra or wings, the two upper ones in the form of cases, and covering the under ones when at rest, which are folded across; they are provided with mandibles and jaws for mastication; the suture betwixt the elytra straight.

SECTION I.—PENTAMERA.

Tarsi with five joints.

FAMILY I.—ADEPHAGI.

Each jaw with two palpi, in all six; antennæ generally filiform, and simple. Tribe i.—Cicendeletæ. Terrestrial. *Cicendela octonotata*, pl. 28, f. 6. Tribe ii.—Carabici. *Brachinus Jurinæ*, f. 7. Tribe iii.—Hydrocanthari. Aquatic. *Colymbetes marmoratus*, f. 8. Tribe iv.—Gyrinites. *Gyrinus sulcatus*, f. 9.

FAMILY II.—BRACHYPTERA.

Body elongated, narrow; antennæ moniliform; each jaw provided with a palpus; elytra shorter than the abdomen, but covering the wings; anal appendages hairy. Tribe i.—Fissilabri. *Oxyporus rufus*, pl. 28, f. 10. Tribe ii.—Longipalpi. *Pæderus ruficollis*, f. 11. Tribe iii.—Depressi. *Lesteva dichroa*, f. 12. Tribe iv.—Microcephali. *Tachinus atricapillus*, f. 13.

FAMILY III.—SERRICORNES.

With filiform or setaceous antennæ, tufted, serrated, or pectinated in the males; some ending in a toothed club; upper part of abdomen covered by the elytra, except in one genus; tarsal penult joint frequently bilobed. Tribe i.—Buprestides. *Buprestis rufipes*, pl. 28, f. 14. Tribe ii.—Elaterides. *Elater areolus*, f. 15. Tribe iii.—Cebrionites. *Rhipicera cyanea*, pl. 29, f. 16. Tribe iv.—Lampyrides. *Lampyris Savignyi*, pl. 28, f. 17. Tribe v.—Melyrides. *Malachius æneus*, pl 29, f. 18. Tribe vi.—Clerii. *Opilo mollis*, f. 19. Tribe vii.—Xylotrogi. *Hylecœtus Dermestoides*, f. 21. Tribe viii.—Ptiniores. *Anobium tesselatum*, f. 20.

FAMILY IV.—CLAVICORNES.

With four palpi, elytra nearly covering the abdomen; antennæ eleven jointed, knobbed at their points; tarsi five jointed. Tribe i.—Hystroida. *Hololepta glabra*, pl. 28, f. 22. Tribe ii.—Peltoides. *Necrophorus mallei*, f. 23. Tribe iii.—Palpatores. *Mastigus palpatis*, pl. 29, f. 25. Tribe iv.—Dermestini. *Dermestes lardarius*, pl. 28, f. 26. Tribe v.—Byrrhi. *Byrrhus pilula*, f. 27. Tribe vi.—Macrodactyli. Aquatic. *Heterocerus marginatus*, pl. 29, f. 28.

FAMILY V.—PALPICORNES.

Antennæ compressed, six or nine jointed, with a perfoliated or solid claviform termination; body hemispherical, or ovoid; mentum large; maxillary palpi long. Tribe i.—Hydrophilii. *Hydrophilus caraboides*, pl. 29, f. 29. Tribe ii.—Sphæridiota. *Sphæridium scarabæoides*, f. 30.

FAMILY VI.—LAMELLICORNES.

Antennæ eight to eleven jointed, but nine or ten the prevailing number, placed in a furrow, short and claviform, consisting of pectinated laminæ; two anterior legs externally dentated; chin large, frequently covering the labium. Tribe i.—Scarabæides. *Oryctes Chevrolatii*, pl. 28, f. 31. The animals of this tribe are numerous, subject to great variety, and are, in consequence, arranged in six sub-tribes. Tribe ii.—Lucanides. *Lucanus cinnamoneus*, f. 32.

SECTION II.—HETEROMERA.

First four tarsi five, and last two four jointed.

FAMILY I.—MELASOMA.

Tarsal joints mostly entire; antennæ moniliform, third joint elongated, always inserted under the projecting borders of the head; point of mandibles bifid; internal side of jaws with a tooth or hook. Tribe i.—Pimeliariæ. *Pimelia vestita*, pl. 28. f. 33. Tribe ii.—Blapsides. *Blaps mortisaga*, f. 34. Tribe iii.—Tenebrionites. *Crypticus gibbulus*, f. 35.

FAMILY II.—TAXICORNES.

Mandibles bifid at their points; joints of tarsi, except the anterior four, entire; antennæ length of head and thorax, with claviform tips, and usually partly perfoliated. Tribe i.—Diaperiales. *Diaperis boleti*, pl. 29, f. 36. Tribe ii.—Cossyphenes. *Cossyphenes Hoffmanseggii*, pl. 28, f. 37. Tribe iii.—Crassicornes. *Cnodalon nodosum*, f. 38.

FAMILY III.—STENELYTRA.

Mandibles sometimes pointed, jaws unarmed; penult joint of tarsi bilobate, antennæ, filiform or setaceous, often longer than the head and thorax. Tribe i.—Helopii. *Helops violaceus*, pl. 28, f. 39. Tribe ii.—Cistelides. *Cistela sulphurea*, pl. 29, f. 40. Tribe iii.—Securipalpi. *Melandrya caraboides*, f. 41. Tribe iv.—Œdemerites. *Œdemera podograria*, f. 42. Tribe v.—Rhynchostoma. *Stenostoma rostrata*.

up of the wings, however, does not prevent the animal's running, leaping, and moving with its natural celerity; but when the case bursts, and the wings have a power of expanding, all the animal's motions become more extensive, and the animal arrives at full perfection. Thus the grasshopper, the dragon-fly, and the earwig, have their wings at first bound down;

FAMILY IV.—TRACHELIDES.

With a cordiform, triangular head, apart from the thorax; antennæ simple, filabelliform, pectinated, or serrated; jaws without corneous teeth; tarsal hooks entire; penult joint usually bilobed. Tribe i.—Lagriariæ. *Lagriaria hirta*, pl. 29, f. 44. Tribe ii.—Pyrochroides. *Pyrochroa coccinea*, f. 45. Tribe iii.—Mordellonæ. *Mordella aculeata*, pl. 28, f. 46. Tribe iv.—Anthicides. *Notoxus monoceros*, pl. 29, f. 47. Tribe v.—Horiales. *Horia maculata*, pl. 28, f. 48. Tribe vi.—Cantharidiæ. *Cantharis vesicatoria*, f. 49.

SECTION III.—TETRAMERA.

All the tarsi four-jointed.

FAMILY I.—RHYNCHOPHORA.

Head rostriform, mouth terminal; antennæ generally claviform, geniculate, and inserted on the proboscis; abdomen large; penult joint of tarsi usually bilobate. Tribe i.—Bruchelæ. *Bruchus pisi*, pl. 29, f. 50. Tribe ii.—Anthribides. *Anthribus latirostris*, f. 51. Tribe iii.—Attelabides. *Attelabus femoralis*, pl. 28, f. 52. Tribe iv.—Brentides. *Brentus anchorago*, pl. 29, f. 52. Tribe v.—Curculionites. *Curculio imperialis*, pl. 28, f. 53.

FAMILY II.—XYLOPHAGI.

Tarsal joints usually entire, or when the penult joint is bilobed, the palpi are small and conical; antennæ frequently with less than eleven joints, claviform, and perfoliated at the base. Tribe i.—Scolytarii. *Scolytus ulmi*, pl. 29, f. 54. Tribe ii.—Bostrichini. *Bostrichus capucinus*, f. 55. Tribe iii.—Paussili. *Paussus microcephalus*, f. 56. Tribe iv.—Trogossitarii. *Dasycerus sulcatus*, f. 57.

FAMILY III.—PLATYSOMA.

Tarsal joints entire; body depressed, oblong; head breadth of body, narrowed behind into a sort of peak; mandibles projecting, especially in the males; labrum small; palpi short; thorax nearly square; antennæ filiform. *Cucujus Dejeanii*, pl. 28, f. 58.

FAMILY IV.—LONGICORNES.

First three joints of tarsus provided with pencils below, two intermediate broad, triangular, or cordiform, third deeply bifoliate; labium triangular, cordiform, or notched; antennæ filiform, generally longer than the body, sometimes inserted in a notch at the eyes, sometimes outside; foot long, slender, with long tarsi; body elongated. Tribe i.—Prionii. *Prionis coriarius*, pl. 28, f. 59. Tribe ii.—Cerambycini. *Ceramblyx hirtipes*, pl. 28, f. 50. Tribe iii.—Necydalides. *Necydalis major*, pl. 29, f. 61. Tribe iv.—Lamiariæ. *Saperda albicans*, pl. 28, f. 62. Tribe v.—Lepturetæ. *Leptura annulata*, pl. 29. f. 63.

FAMILY V.—EUPODA.

Body oblong, antennæ filiform, gradually thickening to the points, and inserted near the eyes; about the length of head and thorax, which is narrow, cylindrical, or square: head sunk in the thorax to nearly the eyes; exterior and terminal lobe of jaws widening towards the extremity. Tribe i.—Sagrides. *Sagra Cayanea*, pl. 29, f. 64. Tribe ii.—Criocerides. *Crioceris merdigera*, pl. 28, f. 65.

FAMILY VI.—CYCLICA.

Labium thick, square, or oval, entire, or slightly notched; exterior and terminal division of jaws cylindrical; body oval, ovoid, globular, or somewhat square; antennæ filiform or setaceous, sometimes slightly claviform, but not rounded or oval; three first joints of tarsi spongy, or provided with brushes below. Tribe i.—Cassidariæ. *Cassida viridis*, pl. 28, f. 66. Tribe ii.—Chrysomelinæ. *Chlamys cuprea*, pl. 29, f. 67. Tribe iii.—Galerucitæ. *Galeruca tanaceti*, pl. 29, f. 68.

FAMILY VII.—CLAVIPALPI.

Three first joints of tarsi with brushes, and the last bifid; antennæ with a terminal, oval, perfoliated club; jaws with a horny tooth interiorly; palpi with a large terminal joint; body orbicular or oval. *Erotylus giganteus*, pl. 28, f. 69.

SECTION IV.—TRIMERA.

Tarsi three jointed; antennæ clavate; body hemispherical or oval.

FAMILY I.—APHIDIPHAGI.

Tarsi with two terminal hooks, first joint distinct; elytra covering the abdomen; antennæ shorter than the thorax, with a terminal club in the form of a reversed triangle; last joint of maxillary palpi being large, dolabriform; body hemispherical; thorax short, and nearly luniform. *Cocinella septempunctata*, pl. 28, f. 70.

FAMILY II.—FUNGICOLÆ.

Tarsi with two terminal hooks, the first joint distinct, elytra covering the abdomen; antennæ longer than the head and thorax; maxillary palpi filiform, or simply thickened towards the tips; body oval. *Eumorphus tetraspilotus*, pl. 29, f. 71.

FAMILY III.—PSELAPHII.

With short truncated elytra; first tarsal joint short and indistinct. *Chennium bituberculatum*, pl. 29, f. 72.

SECTION V.—MONOMERA.

Tarsi having but one joint.

FAMILY I.—DERMESTINI.

Antennæ shorter than the thorax, radical joint large, ovate, seven following short, slender, remaining three forming an ovate compressed club, two lower joints somewhat dilated in the inner side, terminal smaller and rounded. *Dermestes lardarius*, pl. 29, f. 157.

ORDER V.—ORTHOPTERA.

With coriaceous elytra, the margin of the one covering that of the other; mouth provided with mandibles; wings longitudinally folded, and sometimes transversely besides; metamorphosis semi-complete.

SECTION I.

Elytra and wings horizontal; feet formed for running.

FAMILY I.—FORFICULARIÆ.

Tarsi three jointed; elytra nearly crustaceous, not reticulated, very short, posteriorly truncate, joining in a straight suture, and covering the wings, which are plicated, and their extremities projecting beyond the elytra, while in repose; abdomen terminating in a horny forceps. *Forficula spongiphora*, pl. 28, f. 73.

FAMILY II.—BLATTARIÆ.

Tarsi five jointed; wings simply doubled longitudinally, and covered by elytra, frequently coriaceous and thin, reticulated or crossing each other; body depressed, oval, or orbicular; head concealed under the semicircular or orbicular thorax; maxillary palpi long, terminal joint axe-shaped; feet spinous. *Blatta maculata*, pl. 28, f. 74.

but when the skin, that like a pair of stays, kept them confined, bursts, they are then expanded, and the animal pursues the purposes for which it was produced.

FAMILY III.—MANTIDES.

Tarsi five jointed; wings simply folded longitudinally; body elongated, head uncovered; palpi short, filiform; two anterior feet greatly longer than the others, haunches long, thighs strong, compressed; legs terminated by a strong hook, capable of being folded under the thighs; thorax large. *Mantis religiosa*, pl. 28, f. 75.

FAMILY IV.—SPECTRA.

Under lip unequally divided; anterior margin of upper lip notched; antennæ placed nearer the mouth than the centre of the head; head projecting, elongated, and posteriorly rounded; eyes small; first segment of the thorax short, being scarcely longer than the second. *Phyllium psama*, pl. 29, f. 76.

SECTION II.

With the exception of the first family, the elytra and wings are sloping like a roof; posterior thighs and feet very large, and formed for leaping.

FAMILY I.—GRYLLIDES.

Elytra and wings horizontal; antennæ setaceous or filiform, tarsi three jointed. *Gryllus trifasciatus*, pl. 28, f. 77.

FAMILY II.—LOCUSTARIÆ.

Elytra and wings sloping like a roof; tarsi four jointed, antennæ setaceous. *Locusta viridissima*, pl. 29, f. 158.

SECTION III.

Elytra and wings sloping like a roof; posterior feet formed for leaping; tarsi five jointed; elytra alike in both sexes; antennæ sword-shaped, filiform in both sexes, claviform in the males only, in some species.

ACRIDITES.

Posterior feet weak, shorter than the body, hardly formed for leaping; abdomen turned. *Acridium ornatum*, pl. 28, f. 78.

ORDER VI.—HEMIPTERA.

Two wings covered by elytra; mouth constructed for suction; the rostrum composed of a tubular articulated sheath, enveloping four scaly setæ, instead of mandibles and jaws; elytra in some of the species crustaceous, with the posterior extremity membranous; in others nearly similar to wings, but more extended, thicker, and coloured.

SECTION I.—HETEROPTERA.

Rostrum placed on the anterior extremity of the head; elytra and wings horizontal, terminated abruptly by a membranous appendage.

FAMILY I.—GEOCORISÆ.

Antennæ placed near the internal margin of the eyes, and somewhat longer than the head; tarsi three jointed, the first in some species very short. Tribe i.—Longilabra. *Scutellera vasalis*, pl. 28, f. 79. Tribe ii.—Membranaceæ. *Cimex lectularius*, f. 80. Tribe iii.—Nudicollis. *Reduvius raptatorius*, f. 81. Tribe iv.—Oculatæ. *Leptopus littoralis*. Tribe v.—Ploteres. *Hydrometra linearis*, pl. 29, f. 82.

FAMILY II.—HYDROCORISÆ.

Antennæ placed under the eyes, concealed, and even longer than the head; tarsi two jointed. Tribe i.—Nepides. *Belostoma marginata*, pl. 28, f. 84. Tribe ii.—Notonectides. *Noctonecta glauca*, f. 85.

The THIRD ORDER of insects is of the moth and butterfly kind. These all have four wings, each covered with a mealy substance of various colours, which when handled comes off

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SECTION II.—HOMOPTERA.

Rostrum projected from the lower part of the head, between the two anterior feet; elytra generally inclined, of equal thickness throughout, sometimes resembling wings.

FAMILY III.—CICADARIÆ.

With wings and elytra; tarsi three jointed; antennæ small, conical, or subulate; three to six jointed, including the setæ, which terminate them; female ovipositor dentated. Tribe i.—Stridulantes. *Cicada flavopunctata*, pl. 28, f. 86. Tribe ii.—Fulgorellæ. *Fulgora punctata*, f. 87. Tribe iii.—Membracides. *Darnis camelus*, f. 88. Tribe iv.—Cicadella. *Ledra aurata*.

FAMILY IV.—HYMENELYTRA.

Tarsi two jointed, generally with two terminal hooks, or simply vesicular; antennæ ten or eleven jointed, longer than the head; body soft. Tribe i.—Psyllides. *Livia juncorum*, pl. 28, f. 90. Tribe ii.—Physapi. *Thrips physapus*, f. 91. Tribe iii.—Aphidii. *Aphis rosiæ*, f. 92. f. 92 *a*, larva of the same.

FAMILY V.—GALLINSECTA.

Tarsi of one joint, with a terminal hook. Males two winged, or with two elytra, and devoid of a rostrum. Females apterous; antennæ eight, nine, and eleven jointed, and in some instances twenty-two to twenty-four. *Coccus cacti*, pl. 28, f. 93.

ORDER VII.—NEUROPTERA.

Wings four, naked, reticulated and transparent; mouth formed for mastication; jaws and lips straight, extended; joints of the tarsi various, mostly entire.

SECTION I.—SUBULICORNES.

Antennæ little longer than head; subulate, seven jointed, the last formed of a seta; mandibles and jaws covered by lips, or by an anterior projection of the head; eyes projecting, large; wings extended horizontally, or perpendicular.

FAMILY I.—LIBELLULINÆ.

Tarsi three jointed; mandibles and jaws corneous, very strong; dentated; wings equal. *Libellula varia*, pl. 28, f. 94.

FAMILY II.—EPHEMERINÆ.

Tarsi four jointed; body very soft; lower wings much smaller than the upper ones, in some species exceedingly minute; abdomen terminated by two or three filaments. *Ephemera bioculata*, pl. 28, f. 95.

SECTION II.—FILICORNES.

Joints of antennæ generally numerous, thickened towards the end, filiform, or setaceous, and longer than the head.

FAMILY III.—PLANIPENNES.

Tribe i.—Panorpatæ. *Panorpa rufa*, pl. 28, f. 96. Tribe ii.—Myrmeleonides. *Ascalaphus barbarus*, f. 97. Tribe iii.—Hemerobini. *Hemerobius longicornis*, pl. 29, f. 98. Tribe iv.—Psoquillæ. *Psocus bipunctatus*. Tribe v.—Termitinæ. *Termes lucifugum*. Tribe vi.—Raphidinæ *Raphidia ophiopsis*. Tribe vii.—Semblides. *Corydalis cornuta*. Tribe viii.—Perlides. *Perla lutea*.

upon the fingers; and, if examined by the microscope, will appear like scales, with which the wing is nicely embroidered all over. These insects also are produced in a manner peculiar to themselves. They are at first hatched from an egg, from whence proceeds a caterpillar that eats, and often casts its skin; the caterpillar having divested itself for the last time,

FAMILY IV.—PLICIPENNES.

Destitute of mandibles; lower wings broader than the upper, longitudinally folded; antennæ setaceous, usually long, with numerous joints; tarsi five jointed; maxillary palpi long and setaceous. *Phryganea striata.*

ORDER VIII.—HYMENOPTERA.

Four naked veined wings of unequal size; mouth with jaws, mandibles, and two lips; lip tubular at its base, terminating by a labium, either doubled or folded inwards, and forming a kind of sucker; females provided with a compound ovipositor.

SECTION I.—TEREBRANTIA.

Abdomen in many species sessile; females furnished with an ovipositor; antennæ twelve or thirteen jointed, in some more or less.

FAMILY I.—SECURIFERA.

Abdomen perfectly sessile, or connected at its base to the metathorax. Tribe i.—Tenthredinetæ. *Pergu scutellata*, pl. 29, f. 101. Tribe ii.—Urocerata. *Termex columba*, f. 102.

FAMILY II.—PUPIVORA.

Wings of many species cellular, in others devoid of nerves; first abdominal segment posteriorly inclosing the metathorax, and forming part of it; the second, which appears like the first, fixed to the preceding by a pedicle. Tribe i.—Evaniales. *Pelecinus policerator*, pl. 29, f. 103. Tribe ii.—Ichneumonides. *Ichneumon unifasciatorius*, pl. 28, f. 104. Tribe iii.—Gallicolæ. *Cinips quercus folii.* Tribe iv.—Chalcidites. *Chalcis clavipes*, f. 106. Tribe v.—Chrysides. *Chrysis ignita*, f. 107. Tribe vi.—Oxyuri. *Bethyllus hemipterus.*

SECTION II.—ACULEATA.

Abdomen pedunculated, inclosing in the females and neuters a sting; antennæ of the male thirteen jointed, female twelve.

FAMILY III.—HETEROGYNA.

Females and neuters or those which live in society, devoid of wings; antennæ geniculated; labium small, rounded, vaulted. Tribe i.—Formicariæ. *Formica Herculanea*, pl. 28, f. 109. Tribe ii.—Mutillariæ. *Mutilla Klugii*, f. 110.

FAMILY IV.—FOSSORES.

Wings extended; in some the prothorax laterally prolonged, in others short. Tribe i.—Scolietæ. *Scolia tricincta*, pl. 29, f. 111. Tribe ii.—Sapygites. *Sapyga prisma.* Tribe iii.—Pompilii. *Pompilus viaticus*, pl. 28, f. 113. Tribe iv.—Sphegides. *Podium nigripes*, f. 114. Tribe v.—Bembecides. *Bembex rostrata*, f. 115. Tribe vi.—Labratæ. *Labra Ichneumoniformis.* Tribe vii.—Nyssonii. *Nysson maculatus*, pl. 29, f. 117. Tribe viii.—Crabronites. *Crabro cribrarius*, f. 118.

FAMILY V.—DIPLOPTERA.

Wings longitudinally folded; antennæ geniculate, clavate; eyes notched; prothorax reaching insertion of upper wings; feet not fitted for collecting pollen. Tribe i.—Vespariæ. *Synagris cornuta*, pl. 29, f. 119. Tribe ii.—Masarides. *Masaris apiformis*, f. 120.

FAMILY VI.—MELIFERA.

Wings extended; first joint of posterior tarsi large, compressed, square, or triangular, provided with a tuft of hair adapted for collecting pollen of flowers; jaws and lip long, narrow, produced into a proboscis; chin elongated, supported on a pedicle; labium mostly lanceolate or filiform, long and hairy. Tribe i.—Andrenetæ. *Andrena pilipes*, pl. 29, f. 121. Tribe ii.—Apiariæ. *Apis centhuncularia*, pl. 28, f. 122.

ORDER IX.—LEPIDOPTERA.

Four membranaceous wings, covered with a farina composed of minute scales, and having a trunk spirally rolled up, inserted at the mouth.

FAMILY I.—DIURNA.

Wings free in repose, perpendicular to the plane of position, and devoid of a scaly bristle at the base of the inferior wings; antennæ, in many, claviform, or terminating in a button, more or less conical or triangular, in others slender, and hooked at the termination. Tribe i.—Papilionides. *Papilio Childreni*, pl. 29, f. 123. Tribe ii.—Hesperides. *Hesperia malvæ*, f. 124.

FAMILY II.—CREPUSCULARIÆ.

With a stiff, horny bristle near the insertion of the lower wings, at their margin, entering a groove below the upper ones, keeping them horizontal in repose; antennæ claviform elongated, frequently pectinated or serrated. Caterpillars with sixteen large feet. Tribe i.—Hesperia—Sphinges. *Castnia acroeoides*, pl. 29, f. 125. Tribe ii.—Sphingides. *Sphinx convolvuli*, f. 126. Tribe iii.—Zygænides. *Zygæna pulchella*, f. 127.

FAMILY III.—NOCTURNA.

Wings horizontal or inclined in repose; antennæ setaceous. Tribe i.—Bombycites. *Bombyx pavonia*, pl. 29, f. 128. Tribe ii.—Noctuo-Bombycites. *Cossus ligniperda*, f. 127. Tribe iii.—Tineites. *Tinea tapizana*, f. 129. Tribe iv.—Noctuælites. *Noctua oculata*, f. 130. Tribe v.—Tortrices. *Herminia Sidonia*, f. 131. Tribe vi.—Phalænites. *Phalæna machaonaria*, f. 132. Tribe vii.—Crambites. *Crambus retusalis*, f. 133. Tribe viii.—Pterophorites. *Orneodes hexadactylus*, f. 134.

ORDER X.—STREPSIPTERA.

Wings two, naked and membranous, accompanied by two balancers, longitudinally folded, forming nearly the quadrant of a circle; metamorphosis incomplete.

This order consists but of two genera. *Stylops Childreni*, pl. 29, f. 135.

ORDER XI.—DIPTERA.

With two membranous extended wings, and a balancer under each in most species; six feet; provided with a sucker, composed of a variable number of scaly, setæform pieces, either inclosed in the upper furrow of a sheath, or inarticulated proboscis, terminated by two lips, or cased in one or two plates.

SECTION I.

Head large or of medium size, distinct from the thorax; tarsal hooks simple, or unidentated; sucker inclosed in a sheath.

FAMILY I.—NEMOCERA.

Antennæ with six joints at least, but usually with fourteen to sixteen. Tribe i.—Culicides. *Culex pipiens*, pl. 29, f. 136. Tribe ii.—Tipulariæ. *Tipula oleracea*, f. 137

FAMILY II.—TANYSTOMA.

Rostrum frequently lengthened, sometimes nearly concealed; sucker of six pieces. Tribe i.—Tabanii. *Tabanus Africanis*, pl. 29, f. 138. Tribe ii.—Sicarii. *Cœnomyia pallida*, f. 139. Tribe iii.—Mydasii. *Mydas Lusitanicus*, f. 140, *a* and *b*. Tribe iv.—Leptides. *Leptis*

assumes a new covering, which is called a chrysalis, or the cone in the silkworm, in which it continues hidden till it come forth a perfect moth, or butterfly.

The FOURTH ORDER is of those winged insects which come from a worm instead of a caterpillar, and yet go through changes similar to those which moths and butterflies are seen to undergo. They are first excluded from the egg as a worm, and then become a chrysalis; in some, their wings and legs are seen; in others, the animal is quite detached from the cone in which it is concealed; but all at length break their prison and come out perfect winged animals; some furnished with two wings, and some with four. The wings of all these differ from those of the butterfly and moth kind, by not having the mealy scales which are ever found on the wings of the former. In this class we may place the numerous tribes of gnats, beetles, bees, and flies.

To these I will add, as a FIFTH ORDER, a numerous tribe lately discovered, to which naturalists have given the name of Zoophytes. These do not go through the ordinary forms of generation but may be propagated by dissection. Some of these, though cut into a hundred parts, still retain life in each, and are endued with such a vivacious principle, that every part will in a short time become a perfect animal. They seem a set of creatures placed between animals and vegetables, and make the shade that connects animated and insensible nature. To this class belong the polypus, the earth-worm, and all the varieties of the sea-nettle.

Having thus given a general distribution of insects, I will proceed to describe each class in the order I have mentioned them; beginning with insects without wings, as they more nearly resemble the higher ranks of nature, as well in their habits as their conformation.

CHAP. II.

OF INSECTS WITHOUT WINGS.

EVERY moment's observation furnishes us with instances of insects without wings; but the difficulty is to distinguish those which are condemned continually to lead reptile lives, from such as only wait the happy moment of

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fasciata, f. 141. Tribe v.—Dolichopoda. *Porphyrops diaphanus*, f. 142. Tribe vi.—Asilici. *Asilus crabroniformis*, f. 143. Tribe vii.—Hybotini. *Ocydromya glabricula*, f. 144. Tribe viii.—Empides. *Empis pennipes*, f. 145. Tribe ix.—Anthracii. *Anthrax marginicollis*, f. 146. Tribe x.—Bombyliarii. *Bombylius major*, f. 147. Tribe xi.—Vesiculosa. *Henops marginatus*, f. 148.

FAMILY III.—NOTACANTHA.

Rostrum generally membranous, short, concealed, except the terminal lips; sucker of two pieces; in others long, syphon shaped, and concealed by a produced beak, which supports the antennæ; terminal joint of antennæ, with many rings; wings resting on the body, and provided with a central radiated ariola. Tribe i.—Xylophagei. *Beris violaceus*, pl. 29, f. 149. Tribe ii.—Stratiomydes. *Stratiomys chamæleon*, f. 150.

FAMILY IV.—ATHERICERA.

Sucker consisting of two or four pieces, the two contiguous ones provided with palpi; retracted within the sucker into a furrow of the proboscis. Tribe i.—Syrphiæ. *Syrphus obscurus*, pl. 29, f. 151. Tribe ii.—Conopsariæ. *Conops macrocephala*, f. 152. Tribe iii.—Œstrides. *Œstrus Bovis*, f. 153. Tribe iv.—Muscides. *Musca Vomitoria*, f. 154.

SECTION II.

Proboscis consisting of two setæ, emerging from the buccal cavity, covered by two plates or palpi, instead of a sheath.

FAMILY V.—PUPIPARÆ.

Tribe i.—Coriaceæ. *Hippobosca equina*, pl. 29, f. 155. Tribe ii.—Phthyromyiæ. *Nycteribia vespertilionis*, f. 156.

DESCRIPTION OF EXTERNAL PARTS OF INSECTS.

PLATE XXVI.

THE HEAD AND ITS EXTERNAL ORGANS.

The *Head* furnishes the most distinctive characters of insects. It is exceedingly varied in its general form, as well as in its several parts. The most important of these are the *mouth*, *antennæ*, and *eyes*. The head of a Dipterous insect is represented, figure 22, with all its appendages; but the head, independently of these is confined within the limits of *a a* f. 22, 25.

Mouth. This organ is very complicated, and subject to great diversity of form, and construction, admirably adapted to the nature of its food. It consists of six parts, the *labrum*, *mandibles*, *maxillæ*, *palpi*, *labium*, *and mentum*. *Labrum*, or upper lip, figs. 22, 23, 25, *e*, *e*, *e*. *Mandibles*, f. 25, *k*, *k*. *Maxillæ*, f. 24, *i*. *Palpi*, f. 22, 23, 24, 25, *b*, *b*, *b*, *b*, *b*, and f. 29, *b*. *Labial lobes*, f. 22, 23, 25, *g*, *g*, *g*. *Mentum*, f. 29, *a*. *Proboscis*, f. 29, *b*. *Lingua* or tongue, f. 29, *c*.

Antennæ. Horn-like processes consisting of several joints; considered by some naturalists as organs of touch, and by others, organs of hearing, f. 24, 25, *d*, *d*. *Nasus* or nose, f. 22, *f*. *Eyes*, f. 22, *l*, *l*. *Neck*, f. 22, *h*.

The *Thorax* and its several divisions; f. 26. *Collar*, or prothoracic scutellum, f. 22, 26, *m*, *m*. *Præscutum*, f. 26, *n*. *Scutum*, *o*. *Scutellum*, *p*. *Metathoracic Scutum*, f. 26, *q*.

To the thorax are attached the *Wings*, *r*, *r*; the rudimental *alulæ* or winglets *s*; the base of the intermediate *femur t*; the balancers *u*; the base of the posterior femur *v*, and the legs. *Wings*, f. 25, *w*. *Elytra*, are membranous, or horny substances which cover the wings of insects of the order Coleoptera, f. 25, *x*, *x*. *Upper* or superior wing of a Lepidopterous insect, f. 27. *Anterior margin*, or costal nerve, *a*. *Interior margin*, *b*. *Exterior margin*, *c*. *Post-costal nerve*, *d*. *Anal nerve*, *e*. *Compound ocellus*, or the *discoidal cell*, *f*. *Dentate fascia*, *g*.

Lower or inferior wing of a Lepidopterous insect, f. 28. *Anterior margin*, *a*. *Exterior margin*, *b*. *Interior margin*, *c*.

The *Abdomen* is that part which is attached to the posterior extremity of the thorax, and consists of six segments or wings, to which there are never any legs attached, f. 29.

In the whole insect tribe, they are provided with but six *Legs*: they are composed of five parts, f. 30. *Coxa*, or haunch, is the first joint, *a*. *Trochanter*, or second joint, *b*. *Femur*, or thigh, *c*. *Tibia*, or shank, *d*. *Tarsus*, *e*. This member consists of from three to five articulate parts, among Coleopterous insects, and most others. To the last of these articulations are attached the claws.

transmutation. For this, nothing but a long and intimate acquaintance will suffice; but, in general, all animals resembling the flea, the louse, the spider, the bug, the wood-louse, the water-louse, and the scorpion, never acquire wings, but are produced from the egg in that form which they never change afterwards.

If we consider this class as distinct from others, we shall find them in general longer lived than the rest, and often continuing their term beyond one season, which is the ordinary period of an insect's existence. They seem also less subject to the influence of the weather; and often endure the rigours of winter without being numbed into torpidity. The whole race of moths, butterflies, bees, and flies, are rendered lifeless by the return of cold weather; but we need not to be told, that the louse, the flea, and many of these wingless creatures, that seem formed to tease mankind, continue their painful depredations the whole year round.

They come to perfection in the egg, as was said before; and it sometimes happens, that when the animal is interrupted in performing the offices of exclusion, the young ones burst the shell within the parent's body, and are thus brought forth alive. This not unfrequently happens with the wood-louse, and others of the kind, which are sometimes seen producing eggs, and sometimes young ones perfectly formed.

Though these creatures are perfect from the beginning yet they are often, during their existence, seen to change their skin: this is a faculty which they possess in common with many of the higher ranks of animals, and which answer the same purposes. However tender their skins may seem to our feel, yet, if compared to the animal's strength and size, they will be found to resemble a coat of mail, or, to talk more closely, the shell of a lobster. By this skin these animals are defended from accidental injuries, and particularly from the attacks of each other. Within this they continue to grow, till their bodies become so large as to be imprisoned in their own covering, and then the shell bursts, but is quickly replaced by a new one.

Lastly, these animals are endued with a degree of strength, for their size, that at first might exceed credibility. Had man an equal degree of strength, bulk for bulk, with a louse or flea, the history of Samson would be no longer miraculous. A flea will draw a chain a hundred times heavier than itself; and to compensate for this force, will eat ten times its own size of provision in a single day.

CHAP. III.

OF THE SPIDER, AND ITS VARIETIES.[1]

The animal that deserves our first notice in this principal order of insects is the Spider,

[1] Modern naturalists do not rank spiders among insects, because they have no antennæ, and no division between the head and the shoulders; they breathe by leaf-shaped gills, situated under the belly, instead of spiracles in the sides; have a heart connected with these; have eight legs instead of six; and eight fixed eyes. But as spiders are popularly considered insects, it will sufficiently suit our purpose to introduce them here as such. The neatest, though the smallest spider's nest which we have seen, was constructed in the chink of a garden post, which we had cut out the previous summer in getting at the cells of a carpenter-bee. The architect was one of the larger hunting-spiders erroneously said by some naturalists to be incapable of spinning. The nest in question was about two inches high, composed of a very close satin-like texture. There were two parallel chambers placed perpendicularly, in which position also the inhabitant reposed there during the day, going, as we presume, only abroad to prey during the night. But the most remarkable circumstance was, that the openings (two above and two below) were so elastic, that they shut almost as closely as the boat cocoon of the *Tortrix chlorana*. We observed this spider for several months, but at last it disappeared, and we took the nest out, under the notion that it might contain eggs; but we found none, and therefore concluded that it was only used as a day retreat. The account which Evelyn has given of these hunting-spiders is so interesting, that we must transcribe it.

"Of all sorts of insects," says he, "there is none has afforded me more divertisement than the *venatores* (hunters), which are a sort of *lupi* (wolves) that have their dens in rugged walls and crevices of our houses; a small brown and delicately-spotted kind of spiders, whose hinder legs are longer than the rest. Such I did frequently observe at Rome, which, espying a fly at three or four yards distance upon the balcony where I stood, would not make directly to her, but crawl under the rail, till being arrived at the antipodes, it would steal up, seldom missing its aim; but if it chanced to want any thing of being perfectly opposite, would, at first peep, immediately slide down again,—till, taking better notice, it would come the next time exactly upon the fly's back: but if this happened not to be within a competent leap, then would this insect move so softly, as the very shadow of the gnomon seemed not to be more imperceptible, unless the fly moved; and then would the spider move also in the same proportion, keeping that just time with her motion as if the same soul had animated both these little bodies; and whether it were forwards, backwards, or to either side, without at all turning her body, like a well managed horse: but if the capricious fly took wing and pitched upon another place behind our huntress, then would the spider whirl its body so nimbly about, as nothing could be imagined more swift; by which means she always kept the head towards her prey, though, to appearance, as immovable as if it had been a nail driven into the wood, till by that indiscernible progress (being arrived within the sphere of her reach) she made a fatal leap, swift as lightning, upon the fly, catching him in the pole, where she never quitted hold till her belly was full, and then carried the remainder home."

One feels a little sceptical, however, when he adds, "I have beheld them instructing their young ones how to hunt, which they would sometimes discipline for not

whose manners are of all others the most subtle, and whose instincts are most various. Formed for a life of rapacity, and incapable of living upon any other than insect food, all its habits are calculated to deceive and surprise: it spreads toils to entangle its prey; it is endued with patience to expect its coming; and is possessed of arms and strength to destroy it when fallen into the snare.

In this country, where all the insect tribes

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well observing; but when any of the old ones did (as sometimes) miss a leap, they would run out of the field and hide themselves in their crannies, as ashamed, and haply not to be seen abroad for four or five hours after; for so long have I watched the nature of this strange insect, the contemplation of whose so wonderful sagacity and address has amazed me; nor do I find in any chase whatsoever more cunning and stratagem observed. I have found some of these spiders in my garden, when the weather, towards spring, is very hot, but they are nothing so eager in hunting as in Italy."

We have only to add to this lively narrative, that the hunting spider, when he leaps, takes good care to provide against accidental falls by always swinging himself from a good strong cable of silk, as Swammerdam correctly states, and which any body may verify, as one of the small hunters, known by having its back striped with black and white like a zebra, is very common in Britain.

As a contrast to the little elastic satin nest of the hunter, we may mention the largest with which we are acquainted,—that of the labyrinthic spider. Our readers must often have seen this nest spread out like a broad sheet in hedges, furze, and other low bushes, and sometimes on the ground. The middle of this sheet, which is of a close texture, is swung like a sailor's hammock, by silken ropes extended all around to the higher branches; but the whole curves upwards and backwards, sloping down to a long funnel-shaped gallery which is nearly horizontal at the entrance, but soon winds obliquely till it becomes quite perpendicular. This curved gallery is about a quarter of an inch in diameter, is much more closely woven than the sheet part of the web, and sometimes decends into a hole in the ground, though oftener into a group of crowded twigs, or a tuft of grass. Here the spider dwells secure, frequently resting with her legs extended from the entrance of the gallery, ready to spring out upon whatever insect may fall into her sheet net. She herself can only be caught by getting behind her and forcing her out into the web; but though we have often endeavoured to make her construct a nest under our eye, we have been as unsuccessful as in similar experiments with the common house spider.

The house spider's proceedings were long ago described by Homberg, and the account has been copied, as usual, by almost every subsequent writer. Goldsmith has, indeed, given some strange mis-statements from his own observations, and Bingley has added the original remark, that, after fixing its first thread, creeping along the wall and joining it as it proceeds, it "*darts itself to the opposite side*, where the other end is to be fastened!" Homberg's spider took the more circuitous route of travelling to the opposite wall, carrying in one of the claws the end of the thread previously fixed, least it should stick in the wrong place. This we believe to be the correct statement, for as the web is always horizontal, it would seldom answer to commit a floating thread to the wind, as is done by other species. Homberg's spider, after stretching as many lines by way of *warp*, as it deemed sufficient between the two walls of the corner which it had chosen, proceeded to cross this in the way our weavers do in adding the *woof*, with this difference, that the spider's threads were only laid on and not interlaced. The domestic spiders, however, in these modern days, must have forgot this mode of weaving, for none of their webs will be found to be thus regularly constructed.

The geometric, or net-working spiders, are as well known in most districts as any of the preceding; almost every bush and tree in the gardens and hedge rows having one or more of their nets stretched out in a vertical position between adjacent branches. The common garden spider and the long-bodied spider are the best known of this order.



The chief care of a spider of this sort is, to form a cable of sufficient strength to bear the net she means to hang upon it; and, after throwing out a floating line as above described, when it catches properly she doubles and redoubles it with additional threads. On trying its strength she is not contented with the test of pulling it with her legs, but drops herself down several feet from various points of it, as we have often seen, swinging and bobbing with the whole weight of her body. She proceeds in a similar manner with the rest of the frame-work of her wheel-shaped net: and it may be remarked that some of the ends of these are not simple, but in form of a Y, giving her the additional security of two attachments instead of one.

In constructing the body of the net, the most remarkable circumstance is her using her limbs as a measure, to regulate the distances of her *radii* or wheel-spokes, and the circular meshes interweaved into them. These are consequently always proportional to the size of the spider. She often takes up her station in the centre, but not always, though it is so said by inaccurate writers; for she as frequently lurks in a little chamber constructed under a leaf or other shelter at the corner of her web, ready to dart down upon whatever prey may be entangled in her net. The centre of the net is said also to be composed of more viscid materials than its suspensory lines,—a circumstance alleged to be proved by the former appearing under the microscope studded with globules of gum. We have not been able to verify this distinction, having seen the suspensory lines as often studded in this manner as those in the centre.

A no less wonderful structure is composed by a sort of spiders, natives of the tropics and the south of Europe, which have been justly called the mason-spiders by M. Latreille. One of these (*Mygale nidulans*, Walckn.) found in the West Indies, "digs a hole in the earth obliquely downwards, about three inches in length, and one in diameter. This cavity she lines with a tough thick web, which, when taken out, resembles a leathern purse; but what is most curious, this house has a door with hinges, like the operculum of some sea-shells, and herself and family, who tenant this nest, open and shut the door whenever they pass and repass. This history was told me," says Darwin, "and the nest, with its door, shown me by the late Dr Butt, of Bath, who was some years a physician in Jamaica."

are kept under by human assiduity, the spiders are but small and harmless. We are acquainted with few but the house-spider, which weaves its web in neglected rooms; the garden-spider, that spreads its toils from tree to tree, and rests in the centre; the wandering spider, that has no abode like the rest; and the field-spider, that is sometimes seen mounting, web and all, into the clouds. These are the chief of our native spiders; which, though reputed venomous, are entirely inoffensive. But they form a much more terrible tribe in Africa and America. In those regions, where all the insect species acquire their greatest growth, where the butterfly is seen to expand a wing as broad as our sparrow, and the ant to build a habitation as tall as a man, it is not to be wondered at that the spiders are seen bearing a proportionable magnitude. In fact, the bottom of the Martinico spider's body is as large as a hen's egg, and covered all over with hair. Its web is strong, and its bite dangerous. It is happy for us, however, that we are placed at a distance from these formidable creatures, and that we can examine their history without feeling their resentment.

Every spider has two divisions in its body. The fore part, containing the head and breast, is separated from the hinder part or belly by a very slender thread, through which, however, there is a communication from one part to the other. The fore part is covered with a hard-shell, as well as the legs, which adhere to the breast. The hinder part is clothed with a supple skin, beset all over with hair. They have several eyes all round the head, brilliant and acute; these are sometimes eight in number, sometimes but six; two behind, two before, and the rest on each side. Like all other insects, their eyes are immovable, and they want eye-lids; but this organ is fortified with a transparent horny substance, which at once secures and assists their vision. As the animal procures its subsistence by the most watchful attention, so large a number of eyes was necessary to give it the earliest information of the capture of its prey. They have two pincers on the fore part of the head, rough, with strong points, toothed like a saw, and terminating in claws, like those of a cat. A little below the point of the claw there is a small hole, through which the animal emits a poison, which, though harmless to us, is sufficiently capable of instantly destroying its prey. This is the most powerful weapon they have against their enemies; they can open or extend these pincers as occasion may require; and when they are undisturbed, they suffer them to lie one upon the other, never opening them but when there is a necessity for their exertion. They have all eight legs, jointed like those of lobsters, and similar also in another respect; for if a leg be torn away, or a joint cut off, a new one will quickly grow in its place, and the animal will find itself fitted for combat as before. At the end of each leg there are three crooked movable claws, namely, a small one, placed higher up, like a cock's spur, by the assistance of which it adheres to the threads of its web. There are two others larger, which meet together like a lobster's claw, by which they can catch hold of the smallest depressions, walking up or down the very polished surfaces, on which they can find inequalities that are imperceptible to our grosser sight. But when they walk upon such bodies as are perfectly smooth, as looking-glass or polished marble, they squeeze a little sponge, which grows near the extremity of their claws, and thus diffusing a glutinous substance, adhere to the surface until they make a second step. Besides the eight legs

Among our native spiders there are several which, not contented with a web like the rest of their congeners, take advantage of other materials to construct cells where, "hush'd in grim repose," they "expect their insect prey." The most simple of those spider-cells is constructed by a longish-bodied spider, which is a little larger than the common hunting spider. It rolls up a leaf of the lilac or poplar, precisely in the same manner as is done by the leaf-rolling caterpillars, upon whose cells it sometimes seizes to save itself trouble, having first expelled, or perhaps devoured, the rightful owner. The spider however, is not satisfied with the tapestry of the caterpillar, and always weaves a fresh set of her own, much more close and substantial.

Another spider common in woods and copses weaves together a great number of leaves to form a dwelling for herself, and in front of it she spreads her toils for entrapping the unwary insects which stray thither. These, as soon as caught, are dragged into her den, and stored up for a time of scarcity. Here also her eggs are deposited and hatched in safety. When the cold weather approaches, and the leaves of her edifice wither, she abandons it for the more secure shelter of a hollow tree, where she soon dies; but the continuation of the species depends upon eggs, deposited in the nest before winter, and remaining to be hatched with the warmth of the ensuing summer.

The spider's den of united leaves, however, which has just been described, is not always useless when withered and deserted; for the dormouse, or the harvest mouse, we are not certain which, usually selects it as a ready-made roof for its nest of dried grass. That those old spiders' dens are not accidentally chosen by the mouse, appears from the fact, that out of about a dozen mouse-nests of this sort found during winter in a copse between Lewisham and Bromley, Kent, every second or third one was furnished with such a roof.

That spiders may be able to breath under water, we can well understand from their breathing like amphibious reptiles by means of gills; but there is an aquatic spider which is not contented, as a frog would be, with the air furnished by the water, but actually carries down a supply of air from the atmosphere to her subaqueous nest. This spider does not like stagnant water, but prefers slow-running streams and ditches, where she may often be seen, in the vicinity of London and elsewhere, living in her diving-bell, which shines through the water like a little globe of silver: her singular economy was first, we believe, described by Clerck, L. M. de Lignac, and De Geer.—*Rennie's Insect Architecture.*

just mentioned, these animals have two others, which may more properly be called arms, as they do not serve to assist motion, but are used in holding and managing their prey.

The spider, though thus formidably equipped, would seldom prove successful in the capture, were it not equally furnished with other instruments to assist its depredations. As it lives wholly upon flies, and is without wings to pursue them, it is obvious they must for ever escape so important an adversary; but the spider is a most experienced hunter, and spreads its nest to catch those animals it is enabled to pursue. The spider's web is generally laid in those places where flies are most apt to come and shelter; in the corners of rooms, round the edges of windows, and in the open air among the branches of trees. There the little animal remains for days, nay, weeks together, in patient expectation, seldom changing its situation though never so unsuccessful.

For the purposes of making this web, nature has supplied this animal with a large quantity of glutinous matter within its body, and five dugs or teats for spinning it into thread. This substance is contained in a little bag, and at the first sight it resembles soft glue; but when examined more accurately, it will be found twisted into coils of an agate colour, and upon breaking it, the contents may be easily drawn out into threads, from the tenacity of the substance, not from those threads being already formed. Those who have seen the machine by which wire is spun, will have an idea of the manner in which this animal forms the threads of its little net, the orifices of the five teats above mentioned, through which the thread is drawn, contracting or dilating at pleasure. The threads which we see, and appear so fine, are, notwithstanding, composed of five joined together, and these are many times doubled when the web is in formation.

When the house-spider purposes to begin a web, it first makes choice of some commodious spot, where there is an appearance of plunder and security. The animal then distils one little drop of its glutinous liquor, which is very tenacious, and then creeping up the wall, and joining its thread as it proceeds, it darts itself in a very surprising manner, as I have often seen, to the opposite place, where the other end of the web is to be fastened. The first thread thus formed, drawn tight, and fixed at each end, the spider then runs upon it backward and forward, still assiduously employed in doubling and strengthening it, as upon its force depends the strength and stability of the whole. The scaffolding thus completed, the spider makes a number of threads parallel to the first, in the same manner, and then crosses them with others; the clammy substance of which they are formed, serving to bind them, when newly made, to each other. The insect, after this operation, doubles and trebles the thread that borders its web, by opening all its teats at once, and secures the edges, so as to prevent the wind from blowing the work away. The edges being thus fortified, the retreat is next to be attended to: and this is formed like a funnel at the bottom of the web, where the little creature lies concealed. To this are two passages, or outlets, one above and the other below, very artfully contrived, to give the animal an opportunity of making excursions at proper seasons, of prying into every corner, and cleaning those parts which are observed to be clogged or encumbered. Still attentive to its web, the spider, from time to time, cleans away the dust that gathers round it, which might otherwise clog and incommode it: for this purpose, it gives the whole a shake with its paws; still, however, proportioning the blow so as not to endanger the fabric. It often happens, also, that from the main web there are several threads extended at some distance on every side; these are, in some measure, the outworks of the fortification, which, whenever touched from without, the spider prepares for attack or self-defence. If the insect impinging be a fly, it springs forward with great agility; if, on the contrary, it be the assault of an enemy stronger than itself, it keeps within its fortress, and never ventures out till the danger be over. Another advantage the spider reaps from this contrivance of a cell or retreat behind the web, is, that it serves for a place where the creature can feast upon its game with all safety, and conceal the fragments of those carcases which it has picked, without exposing to public view the least trace of barbarity, that might create a suspicion in any insects that their enemy was near.

It often happens, however, that the wind, or rustling of the branches, or the approach of some large animal, destroys in a minute the labours of an age. In this case, the spider is obliged to remain a patient spectator of the universal ruin; and when the danger is passed away, it sets about repairing the calamity. For this purpose, it is furnished with a large store of the glutinous substance of which the web is made; and with this, it either makes a new web, or patches up the old one. In general, however, the animal is much fonder of mending than making, as it is furnished originally with but a certain quantity of glutinous matter, which when exhausted nothing can renew. The time seldom fails to come, when the reservoirs are entirely dried up, and the poor animal is left to all the chances of irretrievable necessity. An old spider is thus frequently reduced to the great-

est extremity; its web is destroyed, and it wants the materials to make a new one. But as these animals have been long accustomed to a life of shifting, it hunts about to find out a web of another spider, younger and weaker than itself, with whom it ventures a battle. The invader generally succeeds; the young one is driven out to make a new web, and the old one remains in quiet possession. If however, the spider is unable to dispossess any other of its web, it then endeavours, for a while, to subsist on accidental depredation; but in two or three months it inevitably dies of hunger.[1]

The garden-spider seems to work in a different manner. The method with this insect is, to spin a great quantity of thread, which floating in the air in various directions, happens, from its glutinous quality, at last to stick to some object near it, a lofty plant or the branch of a tree. The spider only wants to have one end of the line fast, in order to secure and tighten the other. It accordingly draws the line when thus fixed, and then by passing and repassing upon it, strengthens the thread in such a manner as to answer all its intentions. The first cord being thus stretched, the spider walks along a part of it, and there fastens another, and dropping from thence, fastens the thread to some solid body below, then climbs up again and beginsa third, which it fastens by the same contrivance. When three threads are thus fixed, it forms a square, or something that very nearly resembles one, and in this the animal is generally seen to reside. It often happens, however, when the young spider begins spinning, that its web becomes too buoyant, and not only the thread floats in the air, but even the little spinster. In this manner we have often seen the threads of spiders floating in the air; and what is still more surprising, the young spiders themselves attached to their own web. The reason is obvious; for as even gold itself may be so finely drawn out as to float in the air, so the finer threads of a spider are so buoyant as not only to swim in the air, but also to lift the spider itself; which, like the tail of a kite, rises with its own manufacture.

The spider's web being thus completed, and fixed in a proper place, its next care is to seize and secure whatever insect happens to be caught in the toil. For this purpose, it remains for weeks, and even months, upon the watch, without ever catching a single fly; for the spider, like most other insects, is surprisingly patient of hunger. It sometimes happens that too strong a fly strikes itself against the web, and thus, instead of being caught, tears the net to pieces. In general, however, the butterfly or the hornet, when they touch the web, fly off again, and the spider seems no way disposed to interrupt their retreat. The large blue-bottle-fly, the ichneumon-fly, and the common meat-fly, seem to be its favourite game. When one of these strikes into the toils, the spider is instantly seen alert and watchful at the mouth of its hole, careful to observe whether the fly be completely immeshed; if that be the case, the spider walks leisurely forward, seizes its prey, and instantly kills it by instilling a venomous juice into the

[1] From its having been frequently remarked that spiders spread their webs in solitary and confined places, to which it is difficult for flies to penetrate, M. de Vaillant naturally concluded that these creatures must often remain long without food, and that consequently they were capable of enduring considerable abstinence. To ascertain the truth of this circumstance, he took a large garden spider, whose belly was about the size of a nut, and enclosed it under a glass bell, which he secured with cement round its bottom, and left it in that situation for ten months. Notwithstanding this deprivation of food, it appeared during the whole time equally vigorous and alert; but its belly decreased, till at last it was scarcely larger than the head of a pin. He then put under the bell to it another spider of the same species. For a little while they kept at a respectful distance from each other, and remained motionless, but presently the meagre one, pressed by hunger, approached and attacked the stranger. It returned several times to the charge; and, in these different conflicts, its enemy became deprived of almost all its claws; it carried these away, and retired to its former situation to devour them. The meagre one had likewise lost three of its own claws, on which also it fed; and M. de Vaillant perceived that by this repast, its plumpness was in some measure restored. The day following, the new comer, deprived of all its means of defence, fell a complete sacrifice. It was speedily devoured; and in less than twenty-four hours, the old inhabitant of the bell became as plump as it was at the first moment of its confinement.

When two spiders of the same size meet in combat, neither of them will yield; they hold each other by the fangs so fast, that in general one of the two must die before they are separated. M. Leeuwenhoeck says, he saw one spider that was, however, only wounded in one leg by his antagonist. A drop of blood as large as a grain of sand issued from the sore; and not being able to use this wounded leg in running away from his adversary, he held it up, and presently afterwards the whole limb dropped away from his body. When spiders are wounded in the breast, or upper parts of the body, they always die.

The spider, the ptinus, and many insects of the beetle kind, exhibit an instinct of a very extraordinary nature. When put in terror by a touch of the finger, the spider runs off with great swiftness; but if he finds in whatever direction he takes he is opposed by another finger, he then seems to despair of being able to escape, contracts his limbs and body, lies perfectly motionless, and counterfeits every symptom of death. "In this situation," says Smellie, "I have pierced spiders with pins, and torn them to pieces, without their discovering the smallest marks of pain. This simulation of death has been ascribed to a strong convulsion, or stupor, occasioned by terror. But this solution of the phenomenon is erroneous. I have repeatedly tried the experiment, and uniformly found, that, if the object of terror be removed, in a few seconds the animal runs off with the greatest rapidity. Some beetles, when counterfeiting death, will suffer themselves to be gradually roasted without moving a single joint."

wound it makes. If, however, the fly be not entirely immeshed, the spider patiently waits, without appearing until its prey has fatigued itself by its struggles to obtain its liberty; for if the ravager should appear in all its terrors while the prey is but half involved, a desperate effort might give it force enough to get free. If the spider has fasted for a long time, it then drags the fly immediately into its hole, and devours it; but if there has been plenty of game, and the animal be no way pressed by hunger, it then gives the fly two or three turns in its web, so as completely to immesh it, and there leaves it impotently to struggle until the little tyrant comes to its appetite. Why the spider should at one time kill its prey, and at another suffer it to struggle in the toils for several hours together, I am not able to say; perhaps it only likes its prey newly killed, and therefore delays to put the captive to death until it is to be eaten.

It has been the opinion of some philosophers, that the spider was in itself both male and female; but Lister has been able to distinguish the sexes, and to perceive that the males are much less in size than the females. But this is not the chief peculiarity; for, different from all other animals, except the fish called the *Ray*, it has its instruments of generation placed in the fore arms, which have been already described. When these animals copulate, they for some time seize each other with their legs and arms, then appear the instruments of generation in the male, as if bursting out from the points of its fore-feet, and are inserted into the receptacle beneath the body of the female.

The female generally lays from nine hundred to a thousand eggs in a season; they are of a bluish colour, speckled with black, and separated from each other by a glutinous substance, not unlike frog-spawn water. These eggs are large or small in proportion to the size of the animal that produces them. In some they are as large as a grain of mustard-seed; in others they are scarcely visible. The female never begins to lay till she be two years old at the least, and her first brood is never so numerous as when she has come to her greatest maturity.

When the number of eggs which the spider has brought forth have remained for an hour or two to dry after exclusion, the little animal then prepares to make them a bag, where they are to be hatched until they leave the shell. For this purpose she spins a web four or five times stronger than that made for catching flies; and besides, lines it within-side by a down, which she plucks from her own breast. This bag, when completed, is as thick as paper, is smooth within-side, but rougher without. Within this they deposit their eggs; and it is almost incredible to relate the concern and industry which they bestow in the preservation of it. They stick it by means of their glutinous fluid to the end of their body; so that the animal, when thus loaded, appears as if she had one body placed behind another. If this bag be separated from her by any accident, she employs all her assiduity to stick it again in its former situation, and seldom abandons her treasure but with her life. When the young ones are excluded from their shells, within the bag, they remain for some time in their confinement, until the female, instinctively knowing their maturity, bites open their prison, and sets them free. But her parental care does not terminate with this exclusion; she receives them upon her back for some time, until they have strength to provide for themselves, when they leave her never to return, and each begins a separate manufactory of its own. The young ones begin to spin when they can scarcely be discerned; and prepare for a life of plunder before they have strength to overcome. Indeed, Nature seems to have formed them in every respect for a life of hostility. No other insect is possessed of such various powers of assault and defence; and they are able to destroy animals ten times bigger than themselves. Even after a severe defeat, they quickly recover of their wounds; and as for their legs, they consider the loss of them as but a small misfortune, as they grow again very speedily to their former magnitude.

Thus there is no insect to which they are not an enemy; but what is more barbarous still, spiders are the enemies of each other. M. Reaumur, who was fond of making experiments upon insects, tried to turn the labours of the spider to human advantage, and actually made a pair of gloves from their webs.

For this purpose, he collected a large number of those insects together: he took care to have them constantly supplied with flies, and the ends of young feathers, fresh picked from chickens and pigeons, which being full of blood, are a diet that spiders are particularly fond of. But, notwithstanding all his care, he was soon convinced that it was impracticable to rear them, since they were of such a malignant nature, that they could never be brought to live in society; but instead of their usual food, chose to devour each other. Indeed, were it practicable to reconcile them to each other, it would require too much attendance to rear up a sufficient number to make the project any way useful. Their thread is four, if not five times finer than that of the silk-worm; so that, upon the smallest calculation, there must have been sixty thousand spiders to make a single pound of silk. That which Reaumur made use of was only the web in which they deposited their eggs, which is five

times stronger than their ordinary manufacture.

Of this animal, there are several kinds, slightly differing from each other, either in habits or conformation.[1] The Water-spider is the most remarkable of the number. This insect resembles the common spider in its appearance, except that its hinder part is made rather in the shape of a nine-pin than a ball. They differ in being able to live as well by land as water; and on being capable of spinning as well in one element as the other. Their appearance under water is very remarkable; for though they inhabit the bottom, yet they are never touched by the element in which they reside, but are inclosed in a bubble of air that, like a box, surrounds them on every side. This bubble has the bright appearance, at the bottom, of quicksilver: and within this they perform their several functions of eating, spinning, and sleeping, without its ever bursting, or in the least disturbing their operations; sometimes the bubble is seen divided into three distinct apartments; and in the spring, the male enters one of these to impregnate the female in the manner mentioned above, while the bubble in which he was contained unites with the other, like two drops of water when approached to each other. They spin their webs as well in the water as upon land; and it is most probable that they make their food of the small insects of either element.

The Tarantula is also of this species, and deserves particular notice, not for any remarkable properties that really attend it, but for the numerous falsehoods which have been propagated concerning it. What may be said with truth concerning it is, that it is the largest of the spider kind known in Europe, and is a native of Apulia in Italy. Its body is

[1] The gossamer, bird-catching, and branded spiders are among the most remarkable. *Gossamer spiders* first appear in the beginning of October, in woods, gardens, and meadows, where their eggs are hatched in safety; thence they spread themselves over whole districts, and, during the rest of October, and till the middle of November, may be found in dry fields throughout Europe. Extensive tracts of land are sometimes seen swarming with them. In the beginning of October, when but very few are hatched, some single threads of their webs, extending from twig to twig, are seen only in the sunshine: about the middle of the month their threads are more perceptible; and toward the end, if a person stand in such a position as to see the sunbeams play upon their slender threads, hedges, meadows, cornfields, stubble land, and even whole districts, appear covered as with a sort of white gauze. The gossamer spider does not weave a web, but only extends its threads from one place to another. These are so delicate, that a single thread cannot be seen unless the sun shines on it. One of them, to be visible at other times, must be composed of at least six common threads twisted together. In serene, calm days, these spiders work with great diligence, especially after the disappearance of the morning fogs. Between twelve and two, however, their industry excites the greatest admiration. A person with a pretty quick eye, or by the help of a glass, may sometimes perceive among the barley stubble such a multitude of these insects extending their threads, that the fields appear as if covered with swarms of gnats. Several of the single threads become twisted together by the gentlest breath of wind, and form perceptible threads, which, being broken by stronger winds, unite into thick threads, or even into balls, and float through the atmosphere. These are then called in Germany, the *flying summer*, because the summer seems to fly away at the same time. The spiders are conveyed in them: but it is not uncommon to find spiders of other species in them, which have been entangled and dragged away; and even the webs of other spiders, and the dried husks of insects that have been caught by them, are often found in the gossamer. The gossamer-spiders appear in swarms only during the harvest; but single spiders are to be found through the whole summer.

The *Bird-catching Spider* is of gigantic size, and great muscular power, extending with its feet a space of near ten inches. From the head to the extremity of the abdomen it often measures above three inches. The legs are as thick as a goose's quill, and closely covered with hair. The body is brown, and the fangs are as strong and sharp as in some of the rapacious species of birds. It is not uncommon in many parts of America, but is generally found in the southern division of that continent, and particularly in Guinea, and is a terror to all the feathered tribe. It resides in the trees, and frequently seizes on small birds, which it destroys by sucking their blood, after having first wounded them by its fangs, which distil a poisonous liquid into the wound. The slit or orifice near the tip of the fangs, through which this poison is emitted, is so visible as to be distinctly perceived without a glass. The eight eyes of this terrible insect are placed somewhat in the form of an oblong square in the front of the thorax; of these the two middle ones are so large as to be capable of being set in the manner of glasses, and used as microscopes; the rest are smaller, and of an oval shape. The thorax is orbicular, and has a transverse excavation. Captain Stedman, while residing in Surinam, had one of them given to him, which he put into a case bottle above eight inches long; and, when this was filled with spirits, the animal reached the surface with some of its claws, while others rested on the bottom. On the whole, he says, this spider is so hideous a creature, that the very sight of it is sufficient to occasion a tremor of abhorrence, even in persons most accustomed to inspect the deformities of nature.

The *Banded Spider* is a native of Barbary, and is as large as a man's thumb. It has yellow bands round the belly, and dusky rings round the legs. It inhabits hedges and thickets. Its webs have large meshes, and it resides in the centre; the snares are spread for large flies, wasps, drones, and even locusts; the lesser insects can escape through the meshes. The animal which it entangles is soon bound with strong threads, killed by the spider's jaws, and partly eat if the spider be hungry; the rest is concealed under some neighbouring dry leaves, covered with a kind of web, and blackish blue in great abundance: its larder is said to be often plentifully stored. Its nest is of the size of a pigeon's egg, divided horizontally, and suspended by the threads of the insect, which are of a silvery white, and stronger than silk. The young ones live in amity, but when grown up are mortal enemies; they never meet but they fight with violence, and their battle only ends with the death of the weakest: the dead body is carefully stored in the larder. Twelve of these spiders, by way of experiment, were shut up together, and after a battle of eight days the strongest only remained alive.—*Rennie.*

three quarters of an inch long, and about as thick as one's little finger; the colour is generally an olive brown, variegated with one that is more dusky; it has eight legs and eight eyes, like the rest, and nippers, which are sharp and serrated: between these and the fore legs, there are two little horns, or feelers, which it is observed to move very briskly when it approaches its prey. It is covered all over the body with a soft down, and propagates, as other spiders, by laying eggs. In the summer months, particularly in the dog days, the tarantula, creeping among the corn, bites the mowers and passengers; but in winter it lurks in holes, and is seldom seen.

Thus far is true; but now the fable begins: for though the bite is attended with no dangerous symptoms, and will easily cure of itself, wonderful stories are reported concerning its virulence. The part which is bitten, as we are told, is soon after discoloured with a livid, black, or yellowish circle attended with an inflammation. At first the pain is scarcely felt; but a few hours after, come on a violent sickness, difficulty of breathing, fainting, and sometimes trembling. The person bit, after this does nothing but laugh, dance, skip about, putting himself into the most extravagant postures, and sometimes also is seized with a most frightful melancholy. At the return of the season in which he was bit, his madness begins again; and the patient always talks of the same things. Sometimes he fancies himself a shepherd, sometimes a king; appearing entirely out of his senses. These troublesome symptoms sometimes return for several years successively, and at last terminate in death. But so dreadful a disorder has, it seems, not been left without a remedy; which is no other than a well-played fiddle. For this purpose the medical musician plays a particular tune, famous for the cure, which he begins slow, and increases in quickness as he sees the patient affected. The patient no sooner hears the music, but he begins to dance; and continues so doing till he is all over in a sweat, which forces out the venom that appeared so dangerous. This dancing sometimes continues for three or four hours, before the patient is weary and before the sweating is copious enough to cure the disorder. Such are the symptoms related of the tarantula poison; symptoms which some of the best and gravest physicians have credited, and attempted to account for. But the truth is, that the whole is an imposition of the peasants upon travellers who happen to pass through that part of the country, and who procure a trifle for suffering themselves to be bitten by the tarantula. Whenever they find a traveller willing to try the experiment, they readily offer themselves, and are sure to counterfeit the whole train of symptoms which music is supposed to remove. A friend of mine, who passed through that part of the country, had a trusty servant bitten, without ever administering the musical cure: the only symptoms were a slight inflammation, which was readily removed, and no other consequence ever attended the bite.—It is thus that falsehoods prevail for a century or two; and mankind at last begin to wonder how it was possible to keep up the delusion so long.

CHAP. IV.

OF THE FLEA.

The history of those animals with which we are the best acquainted, is the first object of our chiefest curiosity.—There are few but who are well-informed of the agility and blood-thirsty disposition of the Flea; of the caution with which it comes to the attack; and the readiness with which it avoids the pursuit. This insect, which is not only the enemy of mankind, but of the dog, cat, and several other animals, is found in every part of the world, but bites with greater severity in some countries than in others. Its numbers in Italy and France are much greater than in England; and yet its bite is much more troublesome here, than I have found it in any other place. It would seem that its force increased with the coldness of the climate; and, though less prolific, that it becomes more predaceous.[1]

[1] *The Common Flea.*—At a meeting of a Scientific Society at Oxford, some time ago, Mr Hussey, of Christ Church, read a paper on the growth of the flea, in which the changes through which the flea passes were described, and an account was given of some observations of the manner in which changes may be retarded. The flea, it was stated, lays from eight to twelve eggs, which fall down into crevices, or among dust, where they are hatched in about five days; they produce small white maggots like cheese-mites, which increase in size for about fourteen days, when they spin a bag or case of silk around them, and become chrysalids. Within this case they gradually darken in colour, until, at the end of about sixteen days, they come out of it perfect fleas; having been, on the whole, about thirty-four days from the laying of the egg to the perfect state. M. Defrance's opinion concerning the food of the young maggot, was quoted: namely, that it is fed by small grains of dried blood, which the parent has the power of extracting from the skin of the animals on which it feeds.

The strength of this animal is astonishing for its size. A flea will drag after it a chain a hundred times heavier than itself; and, to compensate for this force, will eat ten times its own weight of provisions in a day. Mr Boverich, an ingenious watch-maker who some years ago lived in the Strand, London, exhibited to the public a little ivory chaise, with four wheels, and all its proper apparatus, and a man sitting on the box, all of which were drawn by a single flea. He made a small landau, which opened and shut by springs, with six horses harnassed to it; a coachman sitting on the box, and a dog between his legs, four persons in the carriage, two foot-

If the flea be examined with a microscope, it will be observed to have a small head, large eyes, and a roundish body. It has two feelers, or horns, which are short, and composed of four joints: and between these lies its trunk, which it buries in the skin, and through which it sucks the blood in great quantities. The body appears to be all over curiously adorned with a suit of polished sable armour, neatly jointed, and beset with multitudes of sharp pins, almost like the quills of a porcupine. It has six legs, the joints of which are so adapted, that it can, as it were, fold them up one within another; and when it leaps, they all spring out at once, whereby its whole strength is exerted, and the body raised above two hundred times its own diameter.

The young fleas are at first a sort of nits or eggs, which are round and smooth; and from these proceed white worms, of a shining pearl colour: in a fortnight's time they come to a tolerable size, and are very lively and active; but if they are touched at this time, they roll themselves up in a ball: soon after this they begin to creep like silk-worms that have no legs; and they seek a place to lie hid in, where they spin a silken thread from their mouth, and with this they inclose themselves in a small round bag or case, as white within as writing-paper, but dirty without: in this they continue for a fortnight longer; after which they burst from their confinement perfectly formed, and armed with powers to disturb the peace of an emperor.[1]

men behind it, and a postilion riding on one of the fore horses, which was easily drawn along by a flea. He likewise had a chain of brass, about two inches long, containing two hundred links, with a hook at one end, and a padlock and key at the other, which the flea drew very nimbly along.

[1] The *Chigoe*.—This troublesome insect, which is a kind of small sand flea, is so diminutive as to be almost imperceptible. Its legs have not the elasticity of those of fleas; for had the chigoes their power of leaping, there is not a living creature of the climates where they abound that would not be full of them; and this lurking race would destroy three-fourths of mankind by the evils they would produce. They are common in Surinam, and in many parts of America, and are always found among the dust, and principally in filthy places; they fix themselves on the legs, to the soles of the feet, and even to the fingers.

The chigoe gets in between the skin and the flesh, and generally under the nails of the toes, in such a subtile manner, that, at the time, the person is not sensible of it; nor is it to be perceived till it begins to extend itself. At first it is not difficult to extract it; but, although it may only have introduced its head, it makes so firm a lodgment that a part of the skin must be sacrificed before it will quit its hold. If it be not soon perceived, the insect completes its lodgment, sucks the blood, and forms a nest of a white thin tunicle, in the shape of flat pearl. It extends itself in this space in such a manner, that its head and feet are towards the exterior side, for the convenience of nourishment; and the other part of the body answers to the inner side of the tunicle, in order to lay its eggs there. In proportion as these are laid, the little pearl is enlarged; and in four or five days it is at least four or five lines in diameter. It is then of the utmost consequence to have it extracted; for if this be neglected it bursts of itself, and spreads an infinity of nits, which, when hatched, fill the whole part, and produce excessive anguish; and the difficulty of dislodging them becomes very great. These penetrate to the very bones; and even when the sufferer has got rid of them, the pain will last till the flesh and skin are entirely healed.

The operation of extracting them, at which the black girls are extremely dexterous, is long and painful. It consists in separating, with the point of a needle, the flesh next to the membrane where the eggs are lodged; which is not easily done without bursting the tunicle. After having separated even the most minute ligaments, the nest is to be extracted. If unfortunately it bursts, particular care must be taken to extract every root of it, and especially not to leave behind the principal insect. This would begin to lay its eggs again before the wound could be healed; and penetrating much farther into the flesh, would increase the difficulty of extracting. During the great heats extreme care must be taken not to wet the part affected. Without this precaution, experience has proved that the patient is subject to consequences that frequently prove fatal. Tobacco ashes are put into the orifice, by which, in a little time, the sore is perfectly healed. Some, by having neglected in time to root out these detestable vermin, have not only lost their limbs by amputation, but even their lives.

CHAP. V.

OF THE LOUSE AND ITS VARIETIES.

The antipathies of mankind are various; some considering the toad, some the serpent, some the spider, and some the beetle, with a strong degree of detestation: but while all wonder at the strangeness of each other's aversions, they all seem to unite in their dislike to the Louse, and regard it as their natural and most nauseous enemy. Indeed, it seems the enemy of man in the most odious degree, for wherever wretchedness, disease, or hunger, seize upon him, the louse seldom fails to add itself to the tribe, and to increase in proportion to the number of his calamities.

In examining the human louse with the microscope, its external deformity first strikes us with disgust: the shape of the forepart of the head is somewhat oblong; that of the hind part somewhat round: the skin is hard, and being stretched, transparent, with here and there several bristly hairs: in the forepart is a proboscis or sucker, which is seldom visible: on each side of the head are antennæ, or horns, each divided into five joints, covered with bristly hair; and several white vessels are seen through these horns: behind these are the eyes, which seem to want those divisions observable in other insects, and appear encompassed with some few hairs: the neck is very short, and the breast is divided into three parts; on each side of which are placed six

legs, consisting of six joints, covered also with bristly hairs; the ends of the legs are armed with two smaller and larger ruddy claws, serving these insects as a finger and thumb, by which they catch hold of such objects as they approach: the end of the body terminates in a cloven tail, while the sides are all over hairy; the whole resembling clear parchment, and, when roughly pressed, crackling with a noise.

When we take a closer view, its white veins and other internal parts appear, as likewise a most wonderful motion in its intestines, from the transparency of its external covering. When the louse feeds, the blood is seen to rush, like a torrent, into the stomach; and its greediness is so great, that the excrements contained in the intestines are ejected at the same time, to make room for this new supply.

The louse has neither beak, teeth, nor any kind of mouth, as Dr Hooke described it, for the entrance into the gullet is absolutely closed. In the place of all these, it has a proboscis or trunk: or, as it may be otherwise called, a pointed hollow sucker, with which it pierces the skin, and sucks the human blood, taking that for food only. The stomach is lodged partly in the breast and back; but the greatest portion of it is in the abdomen. When swollen with blood, it appears of a dark brown colour, which is visible through the skin; and is either a faint red, or a full or bright brown, as the contents of the stomach are more or less changed. When it is empty, it is colourless; but when filled, it is plainly discernible, and its motion seems very extraordinary. It then appears working with very strong agitations, and somewhat resembles an animal within an animal. Superficial observers are apt to take this for the pulsation of the heart: but if the animal be observed when it is sucking, it will then be found that the food takes a direct passage from the trunk to the stomach, where the remainder of the old aliment will be seen mixing with the new, and agitated up and down on every side.

If this animal be kept from food two or three days, and then placed upon the back of the hand, or any soft part of the body, it will immediately seek for food; which it will the more readily find, if the hand be rubbed till it grows red. The animal then turns its head, which lies between the two fore-legs, to the skin, and diligently searches for some pore: when found, it fixes the trunk therein, and soon the microscope discovers the blood ascending through the head, in a very rapid, and even frightful stream. The louse has at that time sufficient appetite to feed in any posture; it is then seen sucking with its head downward, and its tail elevated. If, during this operation, the skin be drawn tight, the trunk is bound fast, and the animal is incapable of disengaging itself; but it more frequently suffers from its gluttony, since it gorges to such a degree, that it is crushed to pieces by the slightest impression.

Whether lice are distinguished by the parts of generation into males and females is not yet discovered: Swammerdam is inclined to think that they are hermaphrodites, having found an ovary in all those he examined; and he dissected not less than forty-two. In one of these animals were found ten large eggs; and forty-four smaller, that were not yet come to their full perfection.

There is scarce any animal that multiplies so fast as this unwelcome intruder. It has been pleasantly said, that a louse becomes a grandfather in the space of twenty-four hours: this fact cannot be ascertained; but nothing is more true than that the moment the nit, which is no other than the egg of the louse, gets rid of its superfluous moisture, and throws off its shell, it then begins to breed in its turn. Nothing so much prevents the increase of this nauseous animal as cold and want of humidity; the nits must be laid in a place that is warm, and moderately moist, to produce any thing. This is the reason that many nits laid on the hairs in the night-time, are destroyed by the cold of the succeeding day; and so stick for several months, till they at last come to lose even their external form.

The louse is found upon every part of the human body: but particularly in the heads of children.[1] Those found upon the miners in

[1] All lice live on blood, some on that of man, others on that of quadrupeds. They suck it with their proboscis, which is hardly ever perceived, unless it be in action. There is no quadruped which has not its particular louse, and some nourish several. Man, as we have already seen, is attacked by three species.

Swammerdam, who has given us the anatomy of the human louse, was unable to discover any male among those which he examined. He always found in them an ovary; which occasioned him to suspect that they were hermaphrodites. But the observations of Leeuwenhock, differ much from those of that author. He has observed individuals among these insects provided with all the parts which characterize the male sex, and he has given the figures of those parts. The same author has also discovered in those which he regards as males, a recurved sort of sting, situated under the abdomen, with which, according to him, they can prickle. He believes that the great itching which they occasion proceeds from the pricking of this sting, having remarked that the introduction of their proboscis into the flesh produces scarcely any sensation, unless perchance that it touch on any of the nerves. Degeer tells us, that he has seen a similar sting situated at the end of the abdomen in several human lice as well those of the body, as of the head. The individuals, which according to the opinion of Leeuwenhock are the males, have, according to Degeer, the end of the abdomen rounded, whereas the females, or those which have no sting, have it emarginated. M. Latreille has also observed, very distinctly in a great number of individuals, the sting, or at least the conical and scaly point of which the aforesaid authors have made mention.

Sweden, are said, by Linnæus, to be very large; and he is of opinion that the head and the body-louse differ in no respect from each other. The phthiriasis, or lousy disease, though very little known at present, was frequent enough among the ancients: Herod, Antiochus Epiphanes, Alcman the poet, Pherecydes, Cassander, Callisthenes, and Sylla,

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The multiplication of these insects is unfortunately far too great, but they are not quite so prolific as some have represented. Experiments have proved that in six days a louse can lay fifty eggs, and that some will still remain in the belly. The young ones soon issue from the eggs, (at the end of six days,) and change their skin several times, after which, they are in a state to reproduce. This occurs about eighteen days after, when they begin to lay in their turn. According to these observations, and the calculations to which they have given rise, two female lice may have eighteen thousand descendants in the course of two months.

Linnæus considered the louse, which remains constantly on the human head, as a variety of the common louse. It is, however, from its characters, and also from its undeviating locality, proved to be a distinct species. This same great naturalist also informs us, that the largest lice he ever met with, are to be found in the warm caverns of Fahlun, in Sweden.

Children, and persons who totally neglect their hair, and are otherwise of filthy habits, are generally infested by the head-lice. When powder was fashionable, and preposterously esteemed an embellishment to the hair, it frequently proved a productive cause of these vermin. Those who left too long upon their head the dandriff produced by the use of powder, or who employed adulterated powder for the ornament of their hair, were very liable to the intrusion of these unamiable guests. The other species, which is found on all parts of the body, excepting those of generation, comes generally in consequence of the neglect of personal cleanliness, and the not changing the linen and internal garments sufficiently often. It is from this same species that those persons suffer who are afflicted with that most dreadful and disgusting malady *phthiriasis*. It may be observed that their appearance, though in fewer numbers, is sometimes indicative of the approach, or even of the crisis of other diseases, and that where there is no neglect of personal cleanliness.

As for the third species, we believe, that its appearance is invariably the result of indiscriminate debauchery, accompanied of course with personal neglect.

Dirt attracts these insects, and prepares for them a nidus favourable to the reproduction of their posterity. This is the vice which must be first eradicated if we are desirous of being protected from their inroads, or if already attacked by them, of rendering more efficacious any other means employed for their destruction.

The remedies employed against these vermin act in two ways. Some of them, such as oily and fatty substances, or such as contain azotic gas, close up the stigmata of these insects, or the apertures destined for the admission of air, and smother them. Others, such as the seeds of *staphis agria*, of larks-spur, tobacco, &c. reduced to a powder, produce the effect of a violent poison, and exercise their influence on the general organization of the animals. Mercurial preparations are, of all others, the most certain and speedy agents of their destruction. They may also be employed for the extinction of the species which infest our domestic animals.

It is said that lice, by piercing the skin, often produce pustules which may be converted into itch or tinea. Their multiplication, in certain subjects, is carried to such an extent as to produce the mortal malady which has been already noticed, namely, *morbus pedicularis* or *phthiriasis*. History has afforded us many examples of this; Pheretima, mentioned by Herodotus; Sylla, Antiochus Epiphanes, the two Herods, Maximin, and

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Philip the Second, perished of this disease, or something very analogous to it. Mr Kirby is prone to think that it has fallen particularly as a judgment from God on the oppressors of mankind and the persecutors of religion. But this and all such notions ought to be admitted with caution, or rather rejected altogether. Until it is shown that the disease in question has fallen upon such persons alone, and on no others, we must discard the idea of its being an instrument of Divine vengeance. But this is so far from being the case, that the reverend entomologist himself informs us that "this most loathsome of all maladies, or one equally disgusting, has been the inheritance of the rich, the wise, the noble, and the mighty; and in the list of those who have fallen victims to it, you will find poets, philosophers, princes, kings, and emperors." It would be somewhat hard to believe that among all these there was not one less bloody than the first, or less profligate than the second Herod, less oppressive than Maximin, or less bigotted than Philip. The fact is, diseases of all kinds, like the rain of heaven, fall upon the just and the unjust. They follow, to be sure, as a pretty certain consequence, the indulgence in some vices. Intemperance of all kinds will entail them on the practiser as a necessary, but a *natural* punishment. But the man who unites a sound constitution to a prudent care of his health, may be at once supremely wicked and remarkably healthy. He may cheat and rob, and oppress and murder, but while he avoids the vices which are ruinous to health, he is more likely to find the reward of his villanies here from the indignation of mankind than from any heaven-descended visitation of disease.

Mr Kirby seems doubtful whether all the cases recorded as of *morbus pedicularis* are referrable to the same specific cause. He believes there is sufficient reason for thinking that three different kinds of insects are concerned in the production of diseases which have all been confounded under the name of *phthiriasis*. Besides those produced by *pediculi*, this eminent naturalist refers many cases to the agency of *acari*, or mites, and *larvæ* in general.

It has never been proved, in any well authenticated way, that the species of the genus pediculus burrow beneath the skin, or are *subcutaneous*. This remark is equally applicable to man, and the lower animals, as far as we know anything of the habits of the genus in question. For this we have the highest medical authority, as far as man is concerned. Dr Mead informs us that "the louse feeds on the surface of the skin," and Dr Willan, in a work on cutaneous diseases, states, respecting the body-louse, that "the nits or eggs, are deposited on the small hairs of the skin, and the animals are found on the skin, or on the linen, and not under the cuticle, as some authors have represented." The same writer informs us, "that many marvellous stories are related by Forestus, Schenkius and others, respecting lice bred under the skin, and discharged in swarms from abscesses, strumous ulcers, and vesications. The mode in which pediculi are generated being now so well ascertained, no credit can be given to these accounts." He thinks, however, that those authors have mistaken some other insects for lice, as some such animals may sometimes be found in putrid ulcers.

It appears, therefore, that cases of disease from animals residing under the cuticle, cannot be referred to pediculi. The poet Alcman, and Pherecydes Syrius, the philosopher, are mentioned by Aristotle, as having died of some complaint of this kind. But it could not have been a true phthiriasis, as that great philosopher,

all died of this disorder. The use of mercury, which was unknown among the ancients, may probably have banished it from among the moderns; for certain it is, that these animals seldom attack any in our climate, but such as from sloth or famine invite their company.

Such is the history of the human louse, which, from its connection with mankind, deserves first notice: but it would be endless to describe the various tribes that go under this name, and swarm upon every part of Nature. There is scarce an animal, and scarce even a vegetable, that does not suffer under its own peculiar louse. The sheep, the horse, the hog, and the elephant, are all teased by them; the whale, the shark, the salmon, and the lobster, are not without their company; while every hot-house, and every garden, is infested with some peculiarly destructive. Linnæus tells us, that he once found a vegetable-louse upon some plants newly arrived from America; and, willing to trace the little animal through its various stages, he brought it with him from London to Leyden, where he carefully preserved it during the winter, until it bred in the spring; but the louse it seems did not treat him with all the gratitude he expected; for it became the parent of so numerous a progeny, that it soon overran all the physic-garden of that beautiful city; and leaves, to this day, many a gardener to curse the Swede's too indulgent curiosity.

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who attributed it to lice, imagined; for he tells us, that "they are produced in the flesh, in small pustules, like tumours, which have no pus, and from which, when punctured, they issue." Dr Heberden, in his Commentaries, informs us of a similar case, which he terms *morbus pedicularis*, but which could not be so, for the same reason. He represents the insect as inhabiting tumours, from which, when opened, they issue. He also tells us, that in all respects they resemble the common louse, but in being whiter. But an observer not accurately skilled in entomology, might, as Mr Kirby very justly remarks, easily mistake an *acarus* for a *pediculus*.

Dr Willan has cited two other cases, which he seems to think may with propriety be referred to true *phthiriasis*. In one of these cases, it is stated that the pediculi so abounded, that two black servants had no other employment than that of carrying baskets full of these insects, and throwing them into the sea. This, as Mr Kirby observes, appears to be somewhat exaggerated and hyperbolical. We shall conclude this part of the subject, by observing, that phthiriasis must vary in its types, according to the species of pediculus by which it is produced.

The facts mentioned by Cuvier, that lice abandon the Spanish sailors, in a certain degree of latitude when going to the Indies, and revisit them again on their return, and that body lice are unknown in India, are observations that have need of being corroborated by more certain testimonies than we are yet in possession of. But, if true, there would be nothing in the fact very surprising. A degree of considerable heat, and a more abundant transpiration, might prove unfavourable to the propagation of the *pediculi corporis*. As their skin is more tender, the influence of the air might prove detrimental to them in those burning climates.

The disgusting fact, of these vermin being eaten, is not confined to the Hottentots, the Negroes of Western Africa, and the Simiæ. It has been observed to prevail among some of the American tribes, and is not uncommon even in Europe, as amongst the beggars in Spain and Portugal. Some authors have pointed out the courses which should be adopted to protect or free the person from these disgusting insects. The best of all, in ordinary cases, is cleanliness. Of the medical uses to which these animals have been applied, it is unnecessary to dilate here. No one, we fancy, of the least degree of intelligence, gives any credit to such remedies at present. It was imagined that their introduction into the uretha of new-born infants, troubled with suppression of urine, might, by the titillation which they caused in that canal, force the sphincter to relax, and give passage to the urine. Farriers used to employ the same remedy with horses in similar cases.

The *pediculi* proper, are confined to men and quadrupeds. The *ricini*, or bird-lice, to the feathered race.

It appears that the ancients designated under the name of *ricinus*, those acarides, or acari, vulgarly called ticks, which attach themselves to the skin of dogs, oxen, &c. Degeer might, therefore, have better employed another denomination for the present genus, and which preceding naturalists confounded with that of lice. Accordingly, Dr Leach has adopted, from Herman, the denomination of *nirmus*.

It was by no means surprising, that the earlier naturalists did not distinguish these animals from the lice; their external physiognomy is almost the same, but their organization is different in many essential points, and it is evident that these two genera approximate in a natural series. From the consideration of their resemblances and differences, and from some other facts, furnished by the trachean arachnida, and the branchiopoda, we may see that nature, in preserving always the same type of general forms, is pleased to modify, and sometimes rather abruptly, that of the manducatory apparatus, or that she easily converts organs adapted for grinding, into sucking organs, and *vice versa*. Her views in this respect are subordinate to the model on which the body of the animal is at first formed. This consideration caused M. Latreille to reject as a primary character, the division of insects into two lines—one composed of the grinding, and the other of the sucking insects.

The ricini live exclusively on animals of the class Aves. Degeer, it is true, makes mention of a ricinus found on the body of a dog; but this species M. Latreille refers to pediculus, and could discover no mandibles on it.

These insects remain by preference under the wings, about the axilla, and on the head of birds; they attach themselves there very strongly, by means of the two robust and equal crotchets which terminate their tarsi. They multiply there sometimes, in such quantities, that the birds grow considerably thinner, and may even die in consequence. Care should be taken to examine domestic birds, supposed to be infested by these vermin, and often to clean out the places in which they are kept, and where they are accustomed to rest. By such means they may also be protected from a species of mite, which multiplies prodigiously in such places, and by which these domestic animals are seriously incommoded.

The genus of the ricini is very numerous; there is no bird without one or two species. Redi has figured a great number of them, and though his figures are rude, one may easily see how many varieties the forms of these insects present. Their characters, manners, &c., are, with the exceptions already stated, the same as those of the lice. There is one singularity in the *ricinus pavonis*, and that is, that the antennæ are forked.—*Supplement to the English edition of Cuvier.*

The animal which some have called the Leaf-Louse, is of the size of a flea, and of a bright green, or bluish-green colour; the body is nearly oval, and is largest and most convex on the hinder part; the breast is very small, and the head is blunt and green: the eyes may be seen very plainly, being prominent on the fore part of the head, and of a shining black colour; near these there is a black line on each side; and the legs are very slender.[1]

These animals are usually found on the leaves of the orache, and other plants; and the weaker the leaves and buds are, these insects swarm upon them in greater abundance. Some plants are covered over with them; though they are not the cause of the plant's weakness, but the sign: however, by wounding and sucking the leaf, they increase the disease. They generally assume their colour from the plant on which they reside. Those that feed upon pot-herbs and plum-trees, are of an ash-colour; only they are greenish when they are young: those that belong to the alder and cherry-tree, are black; as also those upon beans, and some other-plants: those on the leaves of apples and rose-trees, are white: but as they leap, like grasshoppers, some place them in the number of the flea kind. The most uncommon colour is reddish; and lice of this sort may be found on the leaves of tansey; and their juice, when rubbed in the hands, tinges them with no disagreeable red. All these live upon their respective plants; and are often engendered within the very substance of the leaf.

All these bring forth their young alive; and the fœtus, when it is ready to be brought forth, entirely fills the belly of the female; its fore parts being excluded first, and then the hinder. The young one does not begin to move till the horns or feelers appear out of the body of the old one; and by the motion of these it first shows signs of life, moving them in every direction, and bending all their joints. When the horns and head are excluded, the two fore-feet follow, which they move with equal agility; after this follow the middle feet, and then the hinder: still, however, the young one continues sticking to its parent, supported only at one extremity, and hanging, as it were, in air, until its small and soft members become hardened and fitted for self-support. The parent then gets rid of its burden; by moving from the place where she was sitting, and forcing the young one to stand upon its legs, leaves it to shift for itself.

As the animal has not far to go, its provisions lying beneath it, during the summer it continues to eat and creep about with great agility. But as it is viviparous, and must necessarily lurk somewhere in winter, where its body may be defended from the cold, it endeavours to secure a retreat near the trees or plants that serve to nourish it in the beginning of spring. They never hide themselves in the earth, like many other insects, because they have no part of their bodies fitted to remove the earth: nor can they creep into every chink, as their legs are too long: besides, their bodies are so tender, that the least rough particle of the earth would hurt them. They, therefore, get into the deep chinks of the bark, and into the cavities of the stronger stalks, from whence they sally out upon the branches and leaves when the warmth of the sun begins to be felt. Neither the cold in the autumnal season, nor the lesser degree of heat in the spring, ever hurts them; they seldom, therefore, seek for hiding-places before the fall of the leaf, and are alert enough to take the earliest advantage of the returning spring.

Like many other insects, they cast their skins four several times: and, what is very remarkable, the males have four wings, but the females never have any. They all have

[1] *Of the Aphides, or Plant Lice.*—The minute animals which compose this singular tribe live entirely on vegetables, and the loftiest trees are as liable to their attacks as the most humble plant. Their numbers are often incalculably great. They prefer the young shoots on account of their tenderness, and frequently insinuate themselves into the very hearts of the plants, doing irreparable mischief even before they are discovered. But for the most part they beset the foliage, and are always found on the under side of the leaf. This they prefer, not only on account of its being most tender, but because it affords them protection from the weather.

Some of the species are constantly and unalterably attached to one or more particular kind of plants; but others feed indiscriminately on most sorts of herbage.

These insects are sometimes winged, and sometimes destitute of wings, without any distinction of sex. In the spring they are viviparous, producing their offspring alive; and in the autumn they are oviparous, depositing their eggs, like most other insects, in places where they remain secure through the winter till the ensuing spring, when they are hatched. The aphides afford also another surprising deviation from the general laws of nature; one impregnation of a female is sufficient for nine generations.

The *larvæ*, *chrysalides*, and perfect insects, have so little difference in external appearance, that they cannot be distinguished from each other.

If the aphides had not many enemies, their increase in summer would be so great, as by wounding and exhausting the tender shoots of the trees, sometimes to suppress their vegetation. Among their enemies, one of the principal is a small black species of ichneumon-fly, which darts its pointed tail into the bodies of the aphides, and at the same time deposits an egg in each. This egg afterwards produces a grub, which feeds on the body of the insect till it has acquired its full growth, when it undergoes its change, and entirely destroys its living nidus.

After a mild spring, most of the species of aphis become so numerous as to do considerable injury to the trees on which they are found. The best mode to remedy this evil is to lop off the infected shoots before the insects greatly multiplied, repeating the same operation before the time that the eggs are deposited. By the first pruning, a very numerous present increase will be prevented; and by the second, the following year's supply may in a great measure be cut off.

long legs, not only to enable them to creep over the long hairs of plants of leaves, but also to travel from one tree to another when they happen to stand at a distance. Their trunk or snout lies under their breast; and this they thrust into the pores of the plant to suck out the juice, for they do not gnaw them, like the caterpillar; but so hurt them by sucking, that the leaves become spotted, and as it were overrun with scabs; for which reason their edges always turn up towards the middle.

It has been said, that these insects are often carried away and devoured by ants; but this Frysch, from whom this description is taken, could never observe. The ants, indeed, are fond of those trees where there is a great number of these insects; but then it is only to suck the juice which flows from the leaves that have been just wounded. This more particularly happens in the heat of summer, when other moisture is wanting: however, he never found them hurting or carrying away any of these insects while alive; nor, indeed, were they able, for the leaf-louse is more than a match for the ant at single combat. Whenever they perceive the ant approaching behind them, they kick back with their hinder-feet, and thus drive off the invader, as a horse would a lion.

The three principal and constant enemies to these insects are, first, the fire-fly, which lays its eggs where these insects are in greatest number, which, producing a worm, seizes and devours all the leaf-lice that come near it: another enemy is the worm of a peculiar kind of beetle, which destroys them in great numbers: but the most formidable of all enemies, is the ichneumon fly, that seizes upon one of the largest females, and laying its egg upon her, this is hatched into a worm, which soon devours and destroys the animal from whose body it sprung.

CHAP. VI.

OF THE BUG AND ITS VARIETIES.

The Bug is another of those nauseous insects that intrude upon the retreats of mankind; and that often banish that sleep, which even sorrow and anxiety permitted to approach. This, to many men, is of all other insects the most troublesome and obnoxious. The night is usually the season when the wretched have rest from their labour; but this seems the only season when the bug issues from its retreats, to make its depredations. By day it lurks, like a robber, in the most secret parts of the bed; takes the advantage of every chink and cranny, to make a secure lodgment; and contrives its habitation with so much art, that scarce any industry can discover its retreat. It seems to avoid the light with great cunning; and if candles be kept burning, this formidable insect will not issue from its hiding-place. But when darkness promises security, it then issues from every corner of the bed, drops from the tester, crawls from behind the arras, and travels with great assiduity to the unhappy patient, who vainly wishes for rest and refreshment. It is generally vain to destroy one only, as there are hundreds more to revenge their companion's fate; so that the person who thus is subject to be bitten, remains the whole night like a centinel upon duty, rather watching the approach of fresh invaders, than inviting the pleasing approaches of sleep.[1]

Nor are these insects less disagreeable from their nauseous stench, than their unceasing appetites. When they begin to crawl, the whole bed is infected with the smell: but if they are accidentally killed, then it is insupportable.

These are a part of the inconveniences that result from the persecution of these odious insects; but happily for Great Britain, they multiply less in these islands than in any part of the continent.[2] In France and Italy the

[1] *Bugs.*—Female bugs lay their eggs four times a-year, namely, in March, May, July, and September, at each season laying fifty eggs; in other words, producing two hundred young in the space of a year. At the age of eleven weeks the young bugs have arrived at maturity, and are ready to become parents in turn. With this data, the following calculation may be made:—Suppose one female bug is allowed to enter a house just before laying time in spring, it will produce 50 young in March, of which 25 may be females. In May, the 26 females (that is, including the mother) will produce 1300 young; take 750 of these as females, we have in July 35,500 young; take 15,750 of these as females, along with the former 750, that will be 16,500 females, which in September will bring forth 825,000 young; take 412,500 of these as females, along with the former, 16,500 females, that will make 429,000, which in the ensuing March will produce 21,450,000; add to these the 429,025 males not reckoned, there is a total of 21,909,025, or very nearly twenty-two millions of bugs, all from a single parent in the course of twelve months. If a knowledge of this fact will not induce activity in extirpating the first bug which makes its appearance in a dwelling, we do not know what will.

[2] The *Bed Bug.*—It is supposed to have been introduced into this country in the fir timber that was brought over for the purpose of rebuilding London, after it had suffered by the great fire. For it is generally said that bugs were not known in England before that time; and many of them were found almost immediately afterwards in the new-built houses. Their most favourite food is blood, dried paste, size, deal, beech, osier, and some other kinds of timber, the sap of which they suck; and on any of these they are able to exist. They will not feed on oak, walnut, cedar, or mahogany; for several pairs which, for the sake of experiment, were confined with these kinds of wood, soon died, whilst those kept with the other continued to thrive through the whole year.

Bugs appear to have been favourite ingredients among

beds, particularly in their inns, swarm with them; and every piece of furniture seems to afford them a retreat. They grow larger also with them than with us, and bite with more cruel appetite.

This animal, if examined minutely, appears to consist of three principal parts; the head, the corselet, and the belly. It has two brown eyes, that are very small, and a little prominent, besides two feelers, with three joints; underneath these there is a crooked trunk, which is its instrument of torture, and which, when in motion, lies close upon the breast. The breast is a kind of ring, in which are placed the two first pair of legs. The belly consists of nine rings; under which are placed two pair of legs more, making six in all. Each leg has three joints, which form the thigh, the leg, and the foot, which is armed with a crooked claw, like a hook. The body is smooth, except a few short hairs, that may be seen by the microscope, about the vent, and on the two last rings. Its motion is slow and unwieldy; yet its sight is so exquisite, that the instant it perceives the light, it generally makes good its retreat; and they are seldom caught, though the bed swarms with them.

If we examine this insect internally, we shall find the great artery, which in all insects performs the functions of the heart; we shall find the apertures of the lungs on the right side and the left, through which the animal breathes; we shall find a stomach and intestines, which, as in other animals, run from the mouth to the anus. If the insect has been long kept fasting, there will be a mucus found in its body, like the white of an egg; but if crushed after a full meal, the human blood which it has sucked in will appear a little darkened, by having passed through the insect's body.

The male and female of these animals are plainly distinguishable from each other; and the parts of generation are obvious enough. They are often found coupling tail to tail; and in this state are very easily destroyed. The female has an ovary filled with eggs, joined together like a bunch of grapes; each egg being an oblong, almost cylindrical, inclining to white, and pretty transparent. In about two days after impregnation by the male, she deposits her eggs to the number of about a hundred and fifty, in some convenient place where they are likely to receive no disturbance. There they continue for some months; during which time, neither cold nor heat, neither moisture nor fumigation, can in the least retard their exclusion; but they come forth active, and ready for mischief.[1] It is this hardiness in the shell that seems to continue the breed; as the old ones die every winter, or are easily destroyed by any fumigation that is used for that purpose. But the eggs seem incapable of destruction; even those men who make a livelihood by killing these nauseous insects, though they can answer for the parent, can never be sure of the egg. For this reason they usually pay those houses to which they are called a second or a third visit, and at last exterminate them by perseverance.

The manner of destroying them seems rather the effects of assiduity than antidote; for the men called in upon this occasion, take every part of the furniture asunder, brush every part of it with great assiduity, anoint it with a liquid which I take to be a solution of corrosive sublimate, and having performed this operation twice or thrice, the vermin are most usually destroyed.

Cleanliness, therefore, seems to be the best antidote to remove these nauseous insects; and wherever that is wanting, their increase seems but a just punishment. Indeed, they are

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the medicaments of ancient doctors. They were prescribed in wine for colic, and an ancient writer says, "It is no new remedy, and it is a certain cure: it once helped a governor of Zurich, so that he had like to have written a commendation in favour of them."

The *Leek-Green Bug*.—The leek-green bug is to be found in Great Britain, as well as in many other parts of Europe. Its body is green, without spots; the abdomen black above, the margin spotted with yellow; the body beneath of a yellowish green; with six yellow legs. The antennæ sometimes entirely reddish brown; their last joints are tipt with black.

The Harvest Bug.—This is one of the most teasing little animals in nature. Though bred and intended, like its congener, the red spider, to live on vegetables, as currents, rasp-berries, and French beans, yet it will desert these, whether by accident or design, to live on and annoy the most delicate and sensitive portion of the human race. These insects are so minute, that they are only visible to the keenest eyes, and then only when placed on any very smooth white surface; in course, they are only known by their effects. Ladies and children are the first to complain of their attacks; and chiefly where any part of the dress fits closely to the skin. There they seat themselves at the intersection of the lines, and lay such firm hold with their feet and jaws, that they cannot be displaced by rubbing, nor by washing, unless a powerful spirit or acid be used. A microscope readily detects them; and, by its assistance, they may be dislodged with the point of a muslin needle, and, if placed on writing-paper, will be seen to have eight legs, two tentacula or feelers, and an abdomen something egg-shaped; colour livid red; and in size no bigger than the point of a small needle. They lacerate the epidermis in some way or other, as a small hole is observable where they have been seated; and cause extreme itching and considerable inflammation of the part.—*Magazine Nat. Hist.*

[1] The female bug (as we have stated in a previous note) generally lays about fifty eggs at a time, which are white, and when protruded are covered with a viscous matter, which afterwards hardening sticks them firmly to the place where they are deposited. These are usually hatched in about three weeks. The young, for some time after they first escape from the egg, are perfectly white, but they generally become brown in the course of about three weeks. In eleven weeks they are at full growth.

sometimes found in such numbers among old furniture and neglected chambers, exposed to the south, that, wanting other sustenance, they devour each other. They are also enemies to other vermin, and destroy fleas very effectually; so that we seldom have the double persecution of different vermin in the same bed. Of the bug kind Linnæus reckons up forty.

CHAP. VII.

OF THE WOOD-LOUSE AND ITS VARIETIES.

The common wood-louse is seldom above half an inch long, and a quarter of an inch broad. The colour is of a livid black, especially when found about dunghills, and on the ground; but those that are to be met with under tiles, and in drier places, are of the colour of the hair of an ass.—It has fourteen feet, seven on each side; and they have only one joint each, which is scarcely perceivable. It has two short feelers, and the body is of an oval shape. When it is touched it rolls itself up into a sort of ball; and the sides near the feet are dentated like a saw. It is often found among rotten timber, and on decayed trees: in winter it lies hid in the crevices of walls and all sorts of buildings. The male is easily distinguishable from the female, being less and more slender. The eggs they lay are white and shining, like seed-pearls, and are very numerous: however, more properly speaking, although, when excluded, the young have all the appearance of an egg, yet they are alive, and, without throwing off any shell, stir and move about with great vivacity; so that this animal may properly be said to be viviparous. The little worms at first seem scarcely able to stir; but they soon feed, and become very brisk. These animals are of great use in medicine, being impregnated with a saline quality, which is diuretic and stimulating. Of this insect, Linnæus makes three species.

CHAP. VIII.

OF THE MONOCULUS; OR, ARBORESCENT WATER-FLEA.

This animal, which is of the size of a flea, appears to the sight, unassisted by the microscope, to have but one eye; for the eyes, by reason of the smallness of the head, seem to be joined to each other: they are situated in the trunk of this insect, and the beak is likewise very small and sharp-pointed. The structure of the eye is seen, by the microscope, to be reticulated, or made like a net; and the trunk of this insect, by which it feeds, is not only small and sharp, but also transparent. The insects are of a blood-red colour; and sometimes are seen in such multitudes on the surface of standing waters, as to make them appear all over red, whence many fanciful people have thought the water to be turned into blood.

Swammerdam tells us of a celebrated professor at Leyden, who was at first astonished by an appearance of this kind. Being once intent upon his studies, he heard a noise, of which, as it increased by degrees, he was desirous to know the cause. The maid-servant attending to his summons, appeared quite petrified with fear, and told him with a tremulous voice, that all the waters of Leyden were turned into blood! Upon this he went directly, in a small bark, to the place where the water was thus changed, and put some of the bloody water into a glass; but upon viewing it with attention, he observed, that it abounded with infinite numbers of these little red insects, which tinged the whole body of the fluid with that seemingly formidable colour. Thus his sudden fright was changed into lasting admiration.[1]

Of all parts of this animal, its branching arms, and the motion it makes with them in the water, deserve our greatest attention. By these the little creature can move in a straight line; waving its arms, as a bird does its wings in the air, sometimes upward, sometimes downward, sometimes to the right, sometimes to the left, yet still continuing to proceed in a right line. By striking the water with its arms, it can ascend with great velocity; and by striking it in a contrary direction, it dives with equal ease. As these motions are very rapid, the little animal appears to jump in the water, its head always tending to the surface, and its tail stretched downward. This insect is produced from an egg, which, when excluded, is

[1] The *Cancroid Monoculus*.—This curious little animal has a convex shell rounded in front, and truncated behind; the tail is furnished with two bristle-shaped processes. This insect is by far the largest of the European monoculi; exhibiting with great distinctness the numerous brachial and other parts, which in the smaller species are only to be viewed by the assistance of the microscope. The Linnæan genus monoculus has, by Fabricius Muller, been subdivided into different distinct genera, on account of the disposition of the eyes, which in some species are approximated, so as to appear as if single, while in others they are remote from each other.

The *Four-horned Monoculus*.—This may be considered as one of the most common of the genus to which it belongs, occuring during the whole year in the clearer ponds of stagnant waters, wells, &c. In the size of the body it scarcely exceeds a large mite, but if measured from the extremities of its limbs, will sometimes be found to equal the eighth of an inch in length. The female is, in general, distinguished by the remarkable appearance of the ovaries, which bear a resemblance to a double cluster of grapes in miniature.

carried on the back of the female, and soon is seen floating in the water round her. Its appearance at first is that of a very small whitish insect, endued with a very nimble motion. Except in colour, it suffers no change, only continuing to grow larger and redder as it grows old. They sometimes remain several days on the surface of the water; and sometimes are seen at the bottom only; but they are never at rest. They change their skin, like most other insects; and the cast skin resembles the insect itself so exactly, that one might mistake the mask for the animal.

CHAP. IX.

OF THE SCORPION AND ITS VARIETIES.[1]

There is scarcely an insect without wings that is not obnoxious to man: the smallest have the power of annoying him, either by biting or stinging him; and though each is in itself contemptible, they become formidable from their numbers. But of all this class, there is none so terrible as the Scorpion, whose shape is hideous, whose size among the insect tribe is enormous, and whose sting is generally fatal. Happy for England, the scorpion is entirely a stranger among us! In several parts of the continent of Europe it is but too well known, though it seldom grows above four inches long: but in the warm tropical climates it is seen a foot in length, and in every respect as large as a lobster.

The scorpion is one of the largest of the insect tribe, and not less terrible from its size than its malignity. It resembles a lobster somewhat in shape, but is infinitely more hideous. There have been enumerated nine different kinds of this dangerous insect, chiefly distinguished by their colour, there being scorpions yellow, brown, and ash coloured; others that are the colour of rusty iron, green, pale yellow, black, claret-colour, white, and gray.

There are four principal parts distinguishable in this animal; the head, the breast, the belly, and the tail. The scorpion's head seems, as it were, jointed to the breast; in the middle of which are seen two eyes; and a little more forward, two eyes more, placed in the fore-part of the head: these eyes are so small, that they are scarcely perceivable; and it is probable the animal has but little occasion for seeing. The mouth is furnished with two jaws; the undermost is divided into two, and the parts notched into each other, which serve the animal as teeth, and with which it breaks its food, and thrusts it into its mouth: these the scorpion can at pleasure pull back into its mouth, so that no part of them can be seen. On each side of the head are two arms, each composed of four joints; the last of which is large, with strong muscles, and made in the manner of a lobster's claw. Below the breast are eight articulated legs, each divided into six joints; the two hindmost of which are each provided with two crooked claws, and here and there covered with hair. The belly is divided into seven little rings; from the lowest of which is continued a tail composed of six joints, which are bristly, and formed like little globes, the last being armed with a crooked sting. This is that fatal instrument which renders this insect so formidable: it is long, pointed, hard, and hollow; it is pierced near the base by two small holes, through which, when the animal stings, it ejects a drop of poison, which is white, caustic, and fatal. The reservoir in which this poison is kept, is in a small bladder near the tail, into which the venom is distilled by a peculiar apparatus. If this bladder be gently pressed, the venom will be seen issuing out through the two holes above-mentioned; so that it appears, that when the animal stings, the bladder is pressed, and the venom issues through the two apertures into the wound.

There are few animals more formidable, or more truly mischievous, than the scorpion. As it takes refuge in a small place, and is generally found sheltering in houses, so it cannot be otherwise than that it must frequently sting those among whom it resides. In some of the towns of Italy, and in France, in the province of Languedoc, it is one of the greatest pests that torment mankind: but its malignity in Europe is trifling, when compared to what the natives of Africa and the East are known to experience. In Batavia, where they grow twelve inches long, there is no removing any piece of furniture, without the utmost danger of being stung by them. Bosman assures us, that, along the Gold Coast, they are often found larger than a lobster; and that their sting is inevitably fatal. In Europe, however, they are by no means so large, so venomous, or so plentiful. The general size of this animal does not exceed two or three inches; and its sting is very seldom found to be fatal. Maupertuis, who made several experiments on the scorpion of Languedoc, found it by no means so invariably dangerous as had till then been represented. He provoked one of them to sting a dog, in three places of the belly, where the animal was without hair: in about an hour after, the poor animal seemed greatly swollen, and became very sick; he then cast up whatever he had in his bowels; and for about three hours continued vomiting a whitish liquid. The belly was always

[1] The Scorpion is placed by naturalists among the *Arachnides* or Spiders.

greatly swollen, when the animal began to vomit; but this operation always seemed to abate the swelling; which alternately swelled, and was thus emptied, for three hours successively. The poor animal, after this, fell into convulsions, bit the ground, dragged himself along upon his fore-feet, and at last died, five hours after being bitten. He was not partially swollen round the place which was bitten, as is usual after the sting of a wasp or a bee; but his whole body was inflated, and there only appeared a red spot on the places where he had been stung.

Some days after, however, the same experiment was tried upon another dog, and even with more aggravated cruelty; yet the dog seemed no way affected by the wounds, but howling a little when he received them, continued alert and well after them; and soon after was set at liberty, without showing the smallest symptoms of pain. So far was this poor creature from being terrified at the experiment, that he left his own master's house, to come to that of the philosopher, where he had received more plentiful entertainment. The same experiment was tried by fresh scorpions, upon seven other dogs, and upon three hens; but not the smallest deadly symptom was seen to ensue. From hence it appears that many circumstances, which are utterly unknown, must contribute to give efficacy to the scorpion's venom. Whether its food, long fasting, the season, the nature of the vessels it wounds, or its state of maturity, contribute to, or retard its malignity, is yet to be ascertained by succeeding experiment. In the trials made by our philosopher, he employed scorpions of both sexes, newly caught and seemingly vigorous and active. The success of this experiment may serve to show, that many of those boasted antidotes which are given for the cure of the scorpion's sting, owe their success rather to accident than their own efficacy. They only happened to cure, when the sting was no way dangerous; but in cases of actual malignity, they might probably be utterly unserviceable.

The scorpion of the tropical climates being much larger than the former, is probably much more venomous. Helbigius, however, who resided for many years in the East, assures us, that he was often stung by the scorpion, and never received any material injury from the wound: a painful tumor generally ensued; but he always cured it, by rubbing the part with a piece of iron or stone, as he had seen the Indians practise before him, until the flesh became insensible. Seba, Moore, and Bosman, however, give a very different account of the scorpion's malignity; and assert, that, unless speedily relieved, the wound becomes fatal.[1]

It is certain that no animal in the creation seems endued with such an irascible nature. I have often seen them taken and put into a place of security, exerting all their rage against the sides of the glass vessel that contained them. I have seen them attempt to sting a stick, when put near them; and attack a mouse or a frog, while those animals were far from offering any injury. Maupertuis put three scorpions and a mouse into the same vessel together, and they soon stung the little animal in different places. The mouse, thus assaulted, stood for some time upon the defensive, and at last killed them all, one after another. He tried this experiment, in order to see whether the mouse, after it had killed, would eat the scorpions; but the little quadruped seemed entirely satisfied with the victory, and even survived the severity of the wounds it had received. Wolkamer tried the courage of the scorpion against the large spider, and enclosed several of both kinds in glass vessels for that purpose.[2] The success of this combat was very remarkable. The spider at first used all its efforts to immesh the scorpion in its web, which he immediately began spinning; but the scorpion rescued itself from the danger, by stinging its adversary to death: it soon after cut off, with its claws, all the legs of the spider, and then sucked all the internal parts at its leisure. If the scorpion's skin had not been so hard, Wolkamer is of opinion that the spider would have obtained the victory; for he had often seen one of these spiders destroy a toad.

The fierce spirit of this animal is equally dangerous to its own species; for scorpions are

[1] Many experiments have been made to ascertain the strength of the poison; and in warm climates it has uniformly been found fatal to the smaller animals. To man the wound is extremely painful. The place becomes inflamed, and the surrounding parts often turn livid, and require to be carefully dressed in order to prevent mortification.

A French physician, who paid great attention to the habits of these animals, has related many particulars respecting them. The care with which the female attended upon her young, and, by degrees, instructed them in the mode of hollowing out their burrow or nest, particularly attracted his attention. He made also many curious experiments on the effects of their poison; by allowing himself to be frequently stung, he discovered that these effects became less and less painful at every repetition, so that, by degrees, he became almost proof against their venom. He describes the part affected as becoming much swollen, and extremely painful, immediately after the infliction of the injury; and, according to the constitution of the individual, this painful feeling continued from twenty-four to forty-eight hours, or even as much as three days. But the most peculiar effect is a sudden and complete prostration of strength, to such an extent that the patient becomes at once deprived of the power of supporting himself. This curious symptom induced the doctor even to propose the use of the sting of the scorpion in medicine, in cases where it became necessary suddenly to reduce the pulsations of the heart.

[2] Ephemerides, Dec. 2, 1687, Observ. 224.

the cruelest enemies to each other. Maupertuis put about a hundred of them together in the same glass; and they scarce came into contact, when they began to exert all their rage in mutual destruction: there was nothing to be seen but one universal carnage, without any distinction of age or sex; so that in a few days there remained only fourteen, which had killed and devoured all the rest.

But their unnatural malignity is still more apparent in their cruelty to their offspring. He enclosed a female scorpion, big with young, in a glass vessel, and she was seen to devour them as fast as they were excluded: there was but one only of the number that escaped the general destruction, by taking refuge on the back of its parent; and this soon after revenged the cause of its brethren, by killing the old one in its turn.

Such is the terrible and unrelenting nature of this insect, which neither the bonds of society nor of nature can reclaim: it is even asserted that, when driven to an extremity, the scorpion will often destroy itself. The following experiment was ineffectually tried by Maupertuis: but I am so well assured of it by many eye-witnesses, who have seen it both in Italy and America, that I have no doubt remaining of its veracity. A scorpion, newly caught, is placed in the midst of a circle of burning charcoal, and thus an egress prevented on every side: the scorpion, as I am assured, runs for about a minute round the circle, in hopes of escaping: but finding that impossible, it stings itself on the back of the head, and in this manner the undaunted suicide instantly expires.

It is happy for mankind that these animals are thus destructive to each other; since otherwise they would multiply in so great a degree as to render some countries uninhabitable. The male and female of this insect are very easily distinguishable; the male being smaller and less hairy. The female brings forth her young alive, and perfect in their kind.[1] Rhedi having brought a quantity of scorpions, selected the females, which by their size and roughness were easily distinguishable from the rest, and putting them in separate glass vessels, he kept them for some days without food. In about five days one of them brought forth thirty-eight young ones, well shaped, and of a milk-white colour, which changed every day more and more into a dark rusty hue. Another female, in a different vessel, brought forth twenty-seven of the same colour: and the day following the young ones seemed all fixed to the back and belly of the female. For near a fortnight all these continued alive and well: but afterwards some of them died daily; until, in about a month, they all died except two.

Were it worth the trouble, these animals might be kept living as long as curiosity should think proper. Their chief food is worms and insects; and upon a proper supply of these, their lives might be lengthened to their natural extent. How long that may be, we are not told; but if we may argue from analogy, it cannot be less than seven or eight years; and perhaps, in the larger kind, double that duration. As they have somewhat the form of the lobster, so they resemble that animal in casting their shell, or more properly their skin; since it is softer by far than the covering of the lobster, and set with hairs, which grow from it in great abundance, particularly at the joinings. The young lie in the womb of the parent each covered up in its own membrane, to the number of forty or fifty, and united to each other by an oblong thread, so as to exhibit altogether the form of a chaplet.

Such is the manner in which the common scorpion produces its young; but there is a scorpion of America, produced from the egg, in the manner of the spider. The eggs are no larger than pin-points; and they are deposited in a web, which they spin from their bodies, and carry about with them till they are hatched. As soon as the young ones are excluded from the shell, they get upon the back of the parent, who turns her tail over them, and defends them with her sting. It seems probable, therefore, that captivity produces that unnatural disposition in the scorpion, which induces it to destroy its young; since, at liberty, it is found to protect them with such unceasing assiduity.[2]

[1] All the scorpion tribe are produced from eggs, of which one female lays a considerable number. After their escape from the egg, they undergo no farther transformation, except occasionally casting their skin like the spider.

CHAP. X.

OF THE SCOLOPENDRA AND GALLY-WORM.

Of these hideous and angry insects we know little, except the figure and the noxious quali-

[2] *Black Scorpion.*—The black Scorpion of Ceylon is a very dangerous insect, and its sting is frequently mortal. This species is about four inches long, and from one to two broad over the middle of the body. When running, or disturbed, their tail is usually carried on their backs. They bite with their fangs, or forceps, and instantly dart the sting, which lies in their tail, into the place they have bitten. Their sting emits a poison resembling milk, but not altogether so white. When these scorpions are attacked by their inveterate enemy the ant, and cannot get rid of him, they sting themselves to death.

The African Scorpion.—The general colour of this animal is a deep brown, nearly approaching in some specimens to black. It grows to a very large size, sometimes nearly a foot long.

ties. Though with us there are insects somewhat resembling them in form, we are placed at a happy distance from such as are really formidable. With us they seldom grow above an inch long; in the tropical climates they are often found above a quarter of a yard.

The Scolopendra is otherwise called the Centipes, from the number of its feet; and it is very common in many parts of the world, especially between the tropics. Those of the East Indies, where they grow to the largest size, are about six inches long, of a ruddy colour, and as thick as a man's finger: they consist of many joints; and from each joint is a leg on each side: they are covered with hair, and seem to have no eyes; but there are two feelers on the head, which they make use of to find out the way they are to pass: the head is very round, with two small sharp teeth, with which they inflict wounds that are very painful and dangerous. A sailor that was bit by one on board a ship, felt an excessive pain, and his life was supposed to be in danger: however, he recovered by the application of three roasted onions to the part, and was soon quite well. Of this animal there are different kinds; some living, like worms, in holes in the earth; others under stones, and among rotten wood; so that nothing is more dangerous than removing those substances, in the places where they breed.[1]

The Gally-worm differs from the scolopendra, in having double the number of feet; there being two on each side, to every joint of the body. Some of them are smooth, and others hairy; some are yellow, some black, and some brown. They are found among decayed trees, between the wood and the bark; as also among stones that are covered with moss. They all, when touched, contract themselves, rolling themselves up like a ball. Whatever may be their qualities in the tropical parts of the world, in Europe they are perfectly harmless; having been often handled and irritated, without any vindictive consequences.

All these, as well as the scorpion, are supposed to be produced perfect from the parent, or the egg; and to undergo no changes after their first exclusion. They are seen of all sizes; and this is a sufficient inducement to suppose, that they preserve their first appearance through the whole of their existence. It is probable, however, that, like most of this class, they often change their skins; but of this we have no certain information.

CHAP. XI.

OF THE LEECH.[2]

The last of this wingless tribe that I shall mention is the Leech, which, like all the for-

[1] *The Great Centipede.*—None of the insect tribe, the scorpions excepted, are so formidable in appearance as the centipede or great scolopendra. It is found in the East and West Indies, and in various parts of Africa, inhabiting chiefly the woods, where it is preyed upon by the different species of snakes. It is, however, sometimes found in houses, and is said to be so common in particular districts, that the inhabitants are obliged to have the feet of their beds placed in vessels of water, in order to prevent their being annoyed during night by these horrible reptiles.

The scolopendræ vary greatly both in size and colour. Some of them are of a deep reddish brown; others of a yellow ochre colour, livid yellow, or tinged with red; and are sometimes seen about a foot in length: they are, however, generally much less. Their legs terminate in very sharp hooks, or nails, of a shining black colour; and all the other legs are furnished with smaller ones of the same kind.

Gronovius says, that all the legs of this detestable animal are venomous; but its most formidable weapons are the two sharp and hooked instruments that are placed under its mouth, with which it destroys its prey. At the extremity of each of these there is a small opening, and from thence extends a tube, through which it is supposed the centipede emits the poisonous fluid into the wound inflicted by these fangs.

Leeuwenhock, desirous of ascertaining the influence of the poison, placed a large fly within reach of a centipede. He seized it between a pair of the middle feet, then passed it from one pair to the next, till it was brought under the fangs, which were plunged into its body, and it died instantly. St Pierre says, that in the Isle of France his dog was bitten by one of them which was upwards of six inches in length, and that the wound turned to a kind of ulcer, which was three weeks in healing. He was highly diverted in observing one of them overcome by a vast number of ants, that attacked it in conjunction, and, after seizing it by all its legs, bore it along as workmen would do a large piece of timber. Its poison is not more injurious than that of the scorpion, and seldom proves fatal to the larger animals.

[2] Cuvier classes leeches with worms, among the Annclida, or invertebrated animals with red blood.

The *Medicinal Leech*, (*Hirudo medicinalis*), may be known by having six yellowish lines, or striæ, on its back, while the under part is of a grayish hue, spotted with black; but, as we shall presently see, these markings are not uniformly found. The medicinal leech is common throughout the whole of Europe, but is much more abundant in the southern parts; it is generally about three inches in length. Formerly it was very abundant in Great Britain, but the improvements in agriculture, and the consequent drainage of the land, together with the great use made of it in medicine, have of late years rendered it of less frequent occurrence. On this account great quantities of leeches are imported; these chiefly come from Bourdeaux and Lisbon. The prevailing colour of the medicinal leech appears to vary according to the nature of the soil on which it is found. In winter the leech retires to waters of considerable depth, and seeks shelter in the mud at the bottom; but in the summer it appears to delight in shallow pools, basking, as it were, in the warmth of the sun: but if the water it frequents is in danger of being dried up by the summer heat, the leech buries itself in the mud at a considerable depth. Just before a thunder-storm, leeches appear much agitated, and rise frequently to the surface of the water; this, therefore, is considered by the *leech-*

mer, undergoes no varieties of transformation; but when once excluded from the body of the parent, preserves its first figure to the end. I place the history of the Leech among the first class of insects; while I have degraded the earth-worm, the Tænia, and the Polypus, into the class of zoophytes, or that imperfect tribe which serves to make the shade between animal and vegetable nature. Not but that the earth-worm or the polypus have their motions, their appetites, and their vital principles, as complete as the leech, and, to a cursory view, appear every way as complete animals. But there is one circumstance that lays the line between them; that exalts the one, and degrades the other. The earth-worm and the polypus may be cut into pieces, and each piece will produce a new and perfect animal: the leech cannot suffer this dissection, but dies when cut in two; an evident instance that it is possessed of a more perfect organization than those animals which it otherwise very much resembles.

The leech, from its uses in medicine, is one of those insects that man has taken care to provide; but, of a great variety, one kind only is considered as serviceable. The horse-leech, which is the largest of all, and grows to four inches in length, with a glossy black surface, is of no use, as it will not stick to the skin; the snail-leech is but an inch in length; and though it will stick, is not large enough to extract a sufficient quantity of blood from the patient; the broad-tailed leech, which grows to an inch and a half in length, with the back raised into a sort of ridge, will stick but on very few occasions: it is the large brown leech, with a whitish belly, that is made use of in medicine, and whose history best merits our curiosity.

The leech has the general figure of a worm, and is about as long as one's middle finger. Its skin is composed of rings, by means of which it is possessed of its agility, and swims in water. It contracts itself, when out of water, in such a manner, that when touched it is not above an inch long. It has a small head, and a black skin, edged with a yellow line on each side, with some yellowish spots on the back. The belly also, which is of a reddish colour, is marked with whitish yellow spots. But the most remarkable part of this animal is the mouth, which is composed of two lips, that take whatever form the insect finds convenient. When at rest, the opening is usually triangular; and within it are placed three very sharp teeth, capable of piercing not only the human skin, but also that of a horse or an ox. Still deeper in the head is discovered the tongue, which is composed of a strong fleshy substance, and which serves to assist the animal in sucking, when it has inflicted its triple wound; for no sooner is this voracious creature applied to the skin, than it buries its teeth therein, then closes its lips round the wounds which it has made; and thus, in the manner of a cupping-glass, extracts the blood as it flows to the different orifices.

In examining this animal's form farther towards the tail, it is seen to have a gullet and an intestinal canal, into which the blood flows in great abundance. On each side of this are seen running along several little bladders, which, when the animal is empty, seem to be filled with nothing but water; but when it is gorging blood, they seem to communicate with the intestines, and receive a large portion of the blood which flows into the body. If these bladders should be considered as so many stomachs, then every leech will be found to have twenty-four. But what is most extraordinary of all in this animal's formation is, that though it takes so large a quantity of food, it has no anus or passage to eject it from the body when it has been digested. On the contrary, the blood which the leech has thus sucked remains for several months clotted within its body, blackened a little by the change, but no way putrified, and very little altered in its texture or consistence. In what manner it passes through the animal's body, or how it contributes to its nourishment, is not easily accounted for. The water in which they are kept is very little discoloured by their continuance; they cannot be supposed to return the blood by the same passage through which it was taken in: it only remains, therefore, that it goes off through the pores of the body, and that these are sufficiently large to permit its exclusion.

But it is not in this instance alone that the leech differs from all other insects. It was remarked in a former chapter, that the whole insect tribe had the opening into their lungs placed in their sides, and that they breathed through those apertures as other animals through the mouth. A drop of oil poured on the sides of a wasp, a bee, or a worm, would quickly suffocate them, by stopping up the passages through which they breathe: but it is otherwise with the leech, for this animal may be immersed in oil without injury; nay, it will live therein; and the only damage it

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gatherers as a favourable time for collecting them. The property by which a leech anticipates thunder, has induced some persons to employ it as a species of barometer; but its indications are very uncertain.

The *Horse-Leech*, (*Hirudo sanguisuga*), is much larger than the medicinal leech, and altogether of a greenish black. It is said to be dangerous, from the wounds which it inflicts; but much difference of opinion exists, even among learned naturalists, as to its power of drawing blood.

Leeches prey on worms, tadpoles, &c., which they devour with avidity.

will sustain is, that, when taken out, it will be seen to cast a fine pellucid skin exactly of the shape of the animal, after which it is as alert and vigorous as before. It appears from hence that the leech breathes through the mouth; and, in fact, it has a motion that seems to resemble the act of respiration in more perfect animals: but concerning all this we are much in the dark.

This animal seems to differ from all others in several respects: the rest of the reptile tribe are brought forth from eggs; the leech is viviparous, and produces its young one after the other, to the number of forty or fifty at a birth.[1] It is probable that, like the snail, each insect contains the two sexes, and that it impregnates and is impregnated in the same manner. The young ones are chiefly found in the month of July, in shallow running waters, and particularly when they are tepified by the rays of the sun. The large ones are chiefly sought after; and being put into a glass vessel filled with water, they remain for months, nay, for years, without taking any other subsistence. But they never breed in this confinement; and, consequently, what regards that part of their history still remains obscure.

[1] It was long a matter of dispute as to whether leeches were produced from eggs or born alive, but it is now ascertained that the ova are developed in a singular case, having some resemblance to the cocoon of a silk-worm. This cocoon is formed by the parent animal, and by it deposited in the mud or clay which composes the bed of the pool it inhabits.

The fact of the young leech being produced from these cocoons, although only latterly ascertained by naturalists, was long since well known to the dealers in leeches on the French coast, who avail themselves of this knowledge of their habits, to multiply them for the purpose of sale. It was by these means the leech-dealers of Bretagne, and particularly in Finisterre, replenished the ponds in which they preserved those leeches which were intended for the Paris market.

About the month of April or May, according to the nature of the season, they send out labourers, provided with spades and baskets, to the little muddy marshes, where they are known to exist in abundance. These workmen then set about removing those portions of mud that are known to contain cocoons, which are afterwards deposited in sheets of water previously prepared for their reception; here the young leeches quit the cocoons, and are allowed to remain six months, when they are removed to larger ponds.

In this part of the world they seldom grow to above four inches; but in America and the East they are found from six to seven. The pools there abound with them in such numbers that it would be dangerous bathing, if for no other consideration. Our sailors and soldiers, who the last war were obliged to walk in those countries through marshy grounds, talk with terror of the number of leeches that infested them on their march. Even in some parts of Europe they increase so as to become formidable. Sedelius, a German physician, relates, that a girl of nine years old, who was keeping sheep near the city of Bomist in Poland, perceiving a soldier making up to her, went to hide herself in a neighbouring marsh among some bushes; but the number of leeches was so great in that place, and they stuck to her so close, that the poor creature expired from the quantity of blood which she lost by their united efforts. Nor is this much to be wondered at, since one of those insects which, when empty, generally weighs but a scruple, will, when gorged, weigh more than two drachms.

When leeches are to be applied, the best way is to take them from the water in which they are contained about an hour before, for they thus become more voracious, and fasten more readily. When saturated with blood, they generally fall off of themselves; but if it be thought necessary to take them from the wound, care should be used to pull them very gently, or even to sprinkle them with salt if they continue to adhere: for if they be plucked rudely away, it most frequently happens that they leave their teeth in the wound, which makes a very troublesome inflammation, and is often attended with danger. If they be slow in fixing to the part, they are often enticed by rubbing it with milk or blood, or water mixed with sugar. As salt is a poison to most insects, many people throw it upon the leech when it has dropped from the wound, by which means it disgorges the blood it has swallowed, and it is then kept for repeated application. They seldom, however, stick after this operation; and as the price is but small, fresh leeches should always be applied whenever such application is thought necessary.

HISTORY OF INSECTS, &c.

BOOK II.

INSECTS OF THE SECOND ORDER.

CHAP. I.

OF THE SECOND ORDER OF INSECTS.

In the former part we gave a concise history of the most considerable insects that, without wings, were produced in a perfect state; either from the body of the parent alive, like quadrupeds, or from the egg, in the manner of birds. We come now to a second order of insects, that are produced from the egg, like the former, but not in a perfect state; for when first excluded, they are without wings. This, however, does not hinder the exercise of their animal functions; the insect, although not yet come to perfection, walks, leaps, and eats; nor is it ever deprived of motion, only that it rests a little when it is about to cast that part of its skin previous to its state of perfection. It is then seen to assume two wings, which, like a budding flower, burst through the case that contained them, and the animal becomes a winged insect in its state of highest perfection. To this order we may refer the Libella, or Dragon-Fly; the Formica Leo, or Lion-Ant; the Grasshopper; the Locust; the Cricket, the Wood-Cricket; the Mole-Cricket; the Flea-Locust; the Flying-Bug; the Tipula; the Water-scorpion; the Notonect, or Water-Fly; and many others.

CHAP. II.

OF THE LIBELLA, OR DRAGON-FLY.

Of all the flies which adorn or diversify the face of nature, these are the most various and the most beautiful: they are of all colours; green, blue, crimson, scarlet, white: some unite a variety of the most vivid tints, and exhibit in one animal more different shades than are to be found in the rainbow. They are called, in different parts of the kingdom, by different names; but none can be at a loss to know them, as they are distinguished from all other flies by the length of their bodies, by the largeness of their eyes, and the beautiful transparency of their wings, which are four in number. They are seen in summer flying with great rapidity near every hedge, and by every running brook; they sometimes settle on the leaves of plants, and sometimes keep for hours together on the wing.

Dragon-flies, though there are three or four different kinds, yet agree in the most striking parts of their history, and one account may serve for all. The largest sort are generally found from two to three inches long; their tail is forked; their body divided into eleven rings; their eyes are large, horny, and transparent, divided by a number of intersections; and their wings, that always lie flat when they are at rest, are of a beautiful glossy transparency; sometimes shining like silver and sometimes glistening like gold. Within the mouth are to be seen two teeth covered with a beautiful lip: with these the creatures bite fiercely when they are taken; but their bite is perfectly harmless, as I have experienced more than once.

These insects, beautiful as they are, are produced from eggs, which are deposited in the water, where they remain for some time without seeming life or motion. They are ejected by the female into the water in clusters, like a bunch of grapes, where they sink to the bottom by their natural weight, and continue in that state till the young ones find strength enough to break the shell, and to separate from each other. The form in which

they first show life, is that of a worm with six legs, bearing a strong resemblance to the dragon-fly in its winged state, except that the wings are yet concealed within a sheath peculiar to this animal. The rudiments of these appear in bunches on the back, within which the wings are folded up into each other, while all colours and varieties of painting appear transparent through the skin. These animals, upon quitting the egg, still continue in the water, where they creep and swim, but do not move swiftly. They have likewise a sharp sight, and immediately sink to the bottom, if any one come to the places wherein they live, or whenever they perceive the least uncommon object. Their food at that time is soft mud and the glutinous earthy substances that are found at the bottom.

When these animals prepare to change from their reptile to their flying state, they then move out of the water to a dry place, as into grass; to pieces of wood, stone, or any thing else they meet with. They there firmly fix their acute claws; and, for a short time, continue quite unmovable, as if meditating on the change they are to undergo. It is then observed, that the skin first opens on the head and back; and out of this opening they exhibit their real head and eyes, and at length their six legs; whilst, in the mean time, the hollow and empty skin, or slough of their legs, remains firmly fixed in its place. After this, the enclosed creature creeps forward by degrees; and by this means draws first its wings and then its body out of the skin; and proceeding a little farther, sits at rest for some time, as if immovable. During this time, the wings, which were moist and folded, begin by degrees to expand themselves, and to make smooth and even all those plaits which were laid against each other, like a closed fan. The body is likewise insensibly extended, until all the limbs have obtained their proper size and dimensions. All these surprising and difficult operations are accomplished by the force of the blood and the circulating humours. The creature cannot at first make use of its new wings, and therefore is forced to stay in the same place until all its limbs are dried by the circumambient air. It soon, however, begins to enter upon a more noble life than it had hitherto led in the bottom of the brook; and from creeping slowly and living accidentally, it now wings the air, and makes choice from amidst the variety of its provisions.

Indeed, no animal is more amply fitted for motion, subsistence, and enjoyment. As it hunts and seeks after its food flying in the air, Nature has provided it with two large eyes, which make almost the whole head, and which resemble glittering mother-of-pearl. It has also four expansive silver-coloured wings, with which, as with oars, it can turn itself with prodigious velocity; and to assist these, it is furnished with a very long body, which, like a rudder, directs its motions. As the wings are long, and the legs short, they seldom walk, but are ever seen either resting or flying. For this reason, they always choose dry branches of trees or shrubs to remain on; and when they have refreshed themselves a little, they renew their flight. Thus they are seen adorning the summer with a profusion of beauty, lightly traversing the air in a thousand directions, and expanding the most beautiful colours to the sun. The garden, the forest, the hedges, and the rivulets, are animated by their sports; and there are few who have been brought up in the country, who have not employed a part of their childhood in the pursuit.

But while these beautiful flies appear to us so idly and innocently employed, they are in fact the greatest tyrants of the insect tribe; and, like the hawk among birds, are only hovering up and down to seize their prey. They are the strongest and the most courageous of all winged insects; nor is there one, how large soever, that they will not attack and devour. The blue-fly, the bee, the wasp, and the hornet, make their constant prey; and even the butterfly, that spreads so large a wing, is often caught and treated without mercy. Their appetite seems to know no bounds; they spend the whole day in the pursuit, and have been seen to devour three times their own size in the capture of a single hour. They seize their prey flying with their six claws, and tear it easily to pieces with their teeth, which are capable of inflicting troublesome wounds.

But the males are upon the wing for another purpose beside that of food, as they are very salacious, and seek the females with great ardour. The sun no sooner begins to warm the fields, than the males are found assiduously employed each in seeking its mate; and no sooner does a female appear, but two or three males are seen pursuing, and endeavouring to seize her with all their arts and agility. The instrument of generation in the male is placed very different from that of any other insect, being not at the end of the tail, as in others, but immediately under the breast, and consequently, at first view, incapable of being united to the sexual part of the female: which, as in order insects, lies in the tail. To perform this junction, Nature has provided the male with a very peculiar manner of proceeding. As soon as he perceives the female, and finds himself sufficiently near, he seizes upon the back of her head by surprise, and fastening his claws upon her, turns round his forky tail, which he fastens round her neck, and in this manner fixes himself so closely and firmly, that no efforts can remove him. It is in vain

that she flies from one branch to another, and settles upon them, he still keeps fixed, and often continues in this situation for three or four hours successively. When he flies, she is obliged to fly with him; but he still directs the way: and though she moves her wings, she seems entirely guided by his motion. As yet, however, the business of impregnation is not performed; for to this the female must contribute; and she at last seems, by the continuance of her constraint, to comply; for, turning up the end of her tail to that part of the breast of the male in which lies the part proper for generation, both instruments meet, and the eggs of the female receive the necessary fecundation. An hour or two after this she flies to some neighbouring pool, where she deposits her eggs, as was already mentioned. There they continue in a reptile state for a year; and then are changed into a beautiful fly, resembling the parent.[1]

CHAP. III.

OF THE FORMICA LEO, OR LION-ANT.

Although this animal properly belongs to no order of insects, yet as it is changed into a fly very much resembling that described in the preceding chapter, it may not be improper to give its history here. If we consider the life of this animal, in its different stages of existence, we shall find it equally wonderful in all; but as it changes to a dragon-fly, what we have said of that animal above, need not be repeated here. The lion-ant, when it becomes an inhabitant of air, in every respect resembles that which has been already described; its glossy wings, its voracious appetites, its peculiar manner of generation, are entirely the same. It is in its reptile state that it differs from all other insects; and in that state it will be amusing to pursue its history.

The lion-ant, in its reptile state, is of the size of a common wood-louse, but somewhat broader. It has a pretty long head and a roundish body, which becomes a little narrower towards the tail. The colour is a dirty gray, speckled with black, and the body is composed of several flat rings, which slip one upon another. It has six feet, four of which are fixed to the breast, and two to the neck. The head is small and flat, and before there are two little smooth horns or feelers, which are hard, about a quarter of an inch long, and crooked at the ends. At the basis of the feelers there are two small black lively eyes, by which it can see the smallest object, as it is easily discovered by its starting from every thing that approaches.

To a form so unpromising, and so ill provided for the purposes of rapacity, this animal unites the most ravenous appetites in nature; but to mark its imbecility still stronger, as other animals have wings or feet to enable them to advance towards their prey, the lion-ant is unprovided with such assistance from either. It has legs, indeed; but these only enable it to run backward, so that it could as soon die as make the smallest progressive motion. Thus famished and rapacious as it ever seems, its prey must come to it, or rather into the snare provided for it, or the insidious assassin must starve.

But Nature, that has denied it strength or swiftness, has given it an equivalent in cunning, so that no animal fares more sumptuously, without ever stirring from its retreat. For this purpose, it chooses a dry sandy place at the foot of a wall, or under some shelter, in order to preserve its machinations from the rain. The driest and most sandy spot is the most proper for it; because a heavy clogged earth would defeat its labour. When it goes about to dig the hole where it takes its prey, it begins to bend the hinder part of its body, which is pointed, and thus works backward; making, after several attempts, a circular furrow, which serves to mark out the size of the hole it intends making, as the ancients marked out the limits of a city with a plough.

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[1] During the grub-state of the dragon-fly, it preys with the most savage ferocity on all aquatic insects. It is, likewise, at this period, furnished with an apparatus at the end of the body, by which it can suck up and eject water with such considerable force, that the stream is perceptible to the distance of two or three inches from their bodies. If they are kept some time out of water, the desire or necessity of respiration is augmented: and accordingly, when replaced in a vessel filled with water, inspirations and respirations are repeated with unusual force and frequency.

The *Depressed Dragon-fly*.—This beautiful insect, the general manners or habits of which resemble those of its cogenera, is of so different a colour in the different sexes, that the shape is the chief criterion of the species. The body of the male is of a bright blue, with brown marginal variegations, while that of the female, on the contrary, is of a bright yellow, with similar marginal markings. Like the libellula grandis, this species is principally seen towards the decline of summer, and flies with great rapidity about the neighbourhood of brooks and stagnant waters. It differs much from other species of this genus, from the body being much flattened.

The *Black-winged Dragon-fly*.—This is one of the most common species in this country, and is generally seen flying, during the morning hours, about the banks of rivers or stagnant waters. The general colour of the body is deep blue-green, while the wings are marked in the middle by a very large patch or area of bluish black. The insect varies, however, in point of colour, more than any other species, and is sometimes seen with the wings perfectly plain or unmarked, and sometimes, on the contrary, entirely blue-black: the tinge of the body also varies in a similar manner, being either bright golden-green, deep livid blue, or sometimes brown.

Within this first furrow it digs a second, then a third, and afterwards others, which are always less than the preceding. Then it begins to deepen its hole, sinking lower and lower into the sand, which it throws with its horns and feelers towards the edges, as we see men throw up sand in a gravel-pit. Thus, by repeating its labours all round, the sand is thrown up in a circle about the edge of the pit, until the whole is quite completed. This hole is always formed in a perfect circle; and the pit itself resembles the inside of an inverted funnel.[1] When this insect first leaves the egg and is newly hatched, the first pit it makes is very small; but as it grows bigger, it makes a larger hole; which is destined, like a pitfall, to entrap its prey. It is generally about two inches deep, and as much in diameter.

[1] *The Ant-Lion.*—The observations of the continental naturalists have made known to us a pitfall constructed by an insect, the details of whose operations are exceedingly curious—we refer to the grub of the ant-lion (*Myrmeleon formicarius*), which, though marked by Dr Turton and Mr Stewart as British, has not (at least of late years) been found in this country. As it is not, however, uncommon in France and Switzerland, it is probable it may yet be discovered in some spot hitherto unexplored.

The ant-lion grub being of a gray colour, and having its body composed of rings, is not unlike a wood-louse (*Oniscus*), though it is larger, more triangular, has only six legs, and most formidable jaws, in form of a reaping-hook, or a pair of calliper compasses. These jaws, however, are not for masticating, but are perforated and tubular, for the purpose of sucking the juices of ants upon which it feeds. Vallisnieri was, therefore, mistaken, as Réaumur well remarks, when he supposed that he had discovered its mouth. Its habits require that it should walk backwards, and this is the only species of locomotion which it can perform. Even this sort of motion it executes very slowly; and were it not for the ingenuity of its stratagems, it would fare but sparingly, since its chief food consists of ants, whose activity and swiftness of foot would otherwise render it impossible for it to make a single capture. Nature, however, in this, as in nearly every other case, has given a compensating power to the individual animal, to balance its privations. The ant-lion is slow—but it is extremely sagacious;—it cannot follow its prey, but it can entrap it.



Grub of the Ant-Lion magnified, with one perfect Trap, and another begun.

The snare which the grub of the ant-lion employs, consists of a funnel-shaped excavation formed in loose sand, at the bottom of which it lies in wait for the ants that chance to stumble over the margin, and cannot, from the looseness of the walls, gain a sufficient footing to effect their escape. When the pitfall is intended to be small, it only thrusts its body backwards into the sand as far as it can, throwing out at intervals the particles which fall in upon it, till it is rendered of the requisite depth.

By shutting up one of these grubs in a box with loose sand, it has been repeatedly observed constructing its trap of various dimensions, from one to three inches in diameter, according to circumstances. When it intends to make one of considerable diameter, it proceeds as methodically as the most skilful architect or engineer amongst ourselves. It first examines the nature of the soil, whether it be sufficiently dry and fine for its purpose, and if so, it begins by tracing out a circle, where the mouth of its funnel-trap is intended to be. Having thus marked the limits of its pit, it proceeds to scoop out the interior. Getting within the circle, and using one of its legs as a shovel, it places therewith a load of sand on the flat part of its head, and it throws the whole with a jerk some inches beyond the circle. It is worthy of remark that it only uses one leg in this operation—the one, namely, which is nearest the centre of the circle. Were it to employ the others in digging away the sand, it would encroach upon the regularity of its plan. Working with great industry and adroitness in the manner we have just described, it quickly makes the round of its circle, and as it works backwards it soon arrives at the point where it had commenced. Instead, however, of proceeding from this point in the same direction as before, it wheels about and works a round in the contrary direction, and in this way it avoids throwing all the fatigue of the labour on one leg, alternating them every round of the circle.

Were there nothing to scoop out but sand or loose earth, the little engineer would have only to repeat the operations we have described, till it had completed the whole. But it frequently happens in the course of its labours, sometimes even when they are near a close, that it will meet with a stone of some size which would, if suffered to remain, injure materially the perfection of its trap. But such obstacles as this do not prevent the insect from proceeding: on the contrary, it redoubles its assiduity to remove the obstruction, as M. Bonnet repeatedly witnessed. If the stone be small, it can manage to jerk it out in the same manner as the sand; but when it is two or three times larger and heavier than its own body, it must have recourse to other means of removal. The larger stones it usually leaves till the last, and when it has removed all the sand which it intends, it then proceeds to try what it can do with the less manageable obstacles. For this purpose, it crawls backwards to the place where a stone may be, and thrusting its tail under it, is at great pains to get it properly balanced on its back, by an alternate motion of the rings composing its body. When it has succeeded in adjusting the stone, it crawls up the side of the pit with great care and deposits its burden on the outside of the circle. Should the stone happen to be round, the balance can be kept only with the greatest difficulty, as it has to travel with its load upon a slope of loose sand which is ready to

The work being thus, with great labour, finished, the insidious insect places itself in ambush, hiding itself in the bottom under the sand, in such a manner that its two horns encircle the bottom of the pit. All the sides of this pit-fall are made of the most loose and crumbling materials; so that scarce any insect can climb up that has once got down to the bottom. Conscious of this, the lion-ant remains in patient expectation, ready to profit by that accident which throws some heedless little animal into its den. If then, by misfortune, an ant, a wood-louse, or a small caterpillar, walks too near the edge of the precipice, the sand gives way beneath them, and they fall to the bottom of the pit, where they meet inevitable destruction. The fall of a single grain of sand gives the murderer notice at the bottom of its cave; and it never fails to sally forth to seize upon its prey. It happens sometimes, however, that the ant or the wood-louse is too nimble, and runs up the sides of the pit-fall before the other can make ready to seize it. The lion-ant has then another contrivance, still more wonderful than the former; for, by means of its broad head and feelers, it has a method of throwing up a shower of sand, which falls upon the struggling captive with tremendous weight, and once more crushes it down to the bottom. When the insect is once fallen thus low, no efforts can retrieve or release it; the lion-ant seizes it with its feelers, which are hollow, and darting them both into its body, sucks out all the little animal's juices with the utmost rapacity.

When the prey is thus reduced to a husk, and nothing but the external form remains, the next care of the murderer is to remove the body from its cell; since the appearance of dead carcases might forewarn other insects of

give way at every step; and often when the insect has carried it to the very brink it rolls off its back and tumbles down to the bottom of the pit. This accident, so far from discouraging the ant-lion, only stimulates it to more persevering efforts. Bonnet observed it renew these attempts to dislodge a stone, five or six times. It is only when it finds it utterly impossible to succeed, that it abandons the design and commences another pit in a fresh situation. When it succeeds in getting a stone beyond the line of its circle, it is not contented with letting it rest there; but to prevent it from again rolling in, it goes on to push it to a considerable distance.

The pitfall, when finished, is usually about three inches in diameter at the top, about two inches deep, and gradually contracting into a point in the manner of a cone or funnel. In the bottom of this pit the ant-lion stations itself to watch for its prey. Should an ant or any other insect wander within the verge of the funnel, it can scarcely fail to dislodge and roll down some particles of sand, which will give notice to the ant-lion below to be on the alert. In order to secure the prey, Réaumur, Bonnet, and others have observed the ingenious insect throw up showers of sand by jerking it from his head in quick succession, till the luckless ant is precipitated within reach of the jaws of its concealed enemy. It feeds only on the blood or juice of insects; and as soon as it has extracted these, it tosses the dry carcase out of its den. Its next care is to mount the sides of the pitfall and repair any damage it may have suffered; and when this is accomplished, it again buries itself among the sand at the bottom, leaving nothing but its jaws above the surface, ready to seize the next victim.

When it is about to change into a pupa, it proceeds in nearly the same manner as the caterpillar of the water-betony moth (*Cucullia scrophulariæ*). It first builds a case of sand, the particles of which are secured by threads of silk, and then tapestries the whole with a silken web. Within this it undergoes its transformation into a pupa, and in due time, it emerges in form of a four-winged fly, closely resembling the dragon-flies (*Libellulæ*), vulgarly and erroneously called *horse-stingers*.

The instance of the ant-lion naturally leads us to consider the design of the Author of Nature in so nicely adjusting, in all animals, the means of destruction and of escape. As the larger quadrupeds of prey are provided with a most ingenious machinery for preying on the weaker, so are these furnished with the most admirable powers of evading their destroyers. In the economy of insects, we constantly observe, that the means of defence, not only of the individual creatures, but of their larvæ and pupæ, against the attacks of other insects, and of birds, is proportioned, in the ingenuity of their arrangements, to the weakness of the insect employing them. Those species which multiply the quickest have the greatest number of enemies. Bradley, an English naturalist, has calculated that two sparrows carry, in the course of a week, above three thousand caterpillars to the young in their nests. But though this is, probably, much beyond the truth, it is certain that there is a great and constant destruction of individuals going forward; and yet the species is never destroyed. In this way a balance is kept up, by which one portion of animated nature cannot usurp the means of life and enjoyment which the world offers to another portion. In all matters relating to reproduction, Nature is prodigal in her arrangements. Insects have more stages to pass through before they attain their perfect growth than other creatures. The continuation of the species is, therefore, in many cases, provided for by a much larger number of eggs being deposited than ever become fertile. How many larvæ are produced, in comparison with the number which pass into the pupa state; and how many pupæ perish before they become perfect insects! Every garden is covered with caterpillars; and yet how few moths and butterflies, comparatively, are seen, even in the most sunny season! Insects which lay few eggs are, commonly, most remarkable in their contrivances for their preservation. The dangers to which insect life is exposed are manifold; and therefore are the contrivances for its preservation of the most perfect kind, and invariably adapted to the peculiar habits of each tribe. The same wisdom determines the food of every species of insect; and thus some are found to delight in the rose-tree, and some in the oak. Had it been otherwise, the balance of vegetable life would not have been preserved. It is for this reason that the contrivances which an insect employs for obtaining its food are curious, in proportion to the natural difficulties of its structure. The ant-lion is carnivorous, but he has not the quickness of the spider, nor can he spread a net over a large surface, and issue from his citadel to seize a victim which he has caught in his outworks. He is therefore taught to dig a trap, where he sits, like the unwieldy giants of fable, waiting for some feeble one to cross his path. How laborious and patient are his operations—how uncertain the chances of success! Yet he never shrinks from them, because his instinct tells him that by these contrivances alone can he preserve his own existence, and continue that of his species.—*Insect Architecture.*

the danger of the place. The insect, therefore, takes up the wasted trunk with its feelers, and throws it, with wonderful strength, at least six inches from the edge of its hole; and then patiently sets about mending the breaches which its fortifications had received in the last engagement. Nothing can abate its industry, its vigilance, its patience, or its rapacity. It will work for a week together to make its pit-fall; it will continue upon the watch for more than a month, patiently expecting the approach of its prey; and if it comes in greater quantities than is needful, yet still the little voracious creature will quit the insect it has newly killed, and leave it half eaten, to kill and attack any other that happens to fall within the sphere of its malignity: though so voracious, it is suprisingly patient of hunger; some of them having been kept in a box with sand for six months and upwards, without feeding at all.

When the lion-ant attains a certain age, in which it is to change into another form, it then leaves off its usual rapacious habits, but keeps on its industry. It no longer continues to make pits, but furrows up the sand all around in an irregular manner; testifying those workings and violent agitations which most insects exhibit previous to their transformation. These animals are produced in autumn, and generally live a year, and perhaps two, before they assume a winged form. Certain it is, that they are found at the end of winter of all sizes; and it would seem that many of the smaller kinds had not yet attained sufficient maturity for transformation. Be this as it may, when the time of change approaches, if the insect finds its little cell convenient, it seeks no other; if it is obliged to remove, after furrowing up the sand, it hides itself under it, horns and all.—It there spins a thread, in the manner of the spider; which being made of a glutinous substance, and being humid from the moisture of its body, sticks to the little particles of sand among which it is spun; and in proportion as it is thus excluded, the insect rolls up its web, sand and all, into a ball, of which itself is the centre. This ball is about half an inch in diameter; and within it the insect resides, in an apartment sufficiently spacious for all its motions. The outside is composed of sand and silk; the inside is lined with silk only, of a fine pearl-colour, extremely delicate, and perfectly beautiful. But though the work is so curious within, it exhibits nothing to external appearance but a lump of sand; and thus escapes the search of birds that might otherwise disturb the inhabitant within. The insect continues thus shut up for six weeks or two months; and gradually parts with its eyes, its feelers, its feet, and its skin; all which are thrust into a corner of the inner apartment, like a rag. The insect then appears almost in its winged state, except that there is a thin skin which wraps up the wings, and that appears to be nothing else but a liquor dried on their outside. Still, however, the little animal is too delicate and tender to venture from its retreat; but continues enclosed for sometime longer: at length, when the members of this new insect have acquired the necessary consistence and vigour, it tears open its lodging, and breaks through its wall. For this purpose it has two teeth, like those of grasshoppers, with which it eats through, and enlarges the opening, till it gets out. Its body, which is turned like a screw, takes up no more than the space of a quarter of an inch; but when it is unfolded, it becomes half an inch in length; while its wings, that seemed to occupy the smallest space, in two minutes' time unfold, and become longer than the body. In short, it becomes a large and beautiful fly, of the libellula kind, with a long slender body, of a brown colour; a small head, with large bright eyes, long slender legs, and four large transparent reticulated wings. The rest of its habits resemble that insect whose form it bears; except, that instead of dropping its eggs in the water, it deposits them in sand, where they are soon hatched into that rapacious insect so justly admired for its method of catching its prey.

CHAP. VI.

OF THE GRASSHOPPER, THE LOCUST, THE CICADA, THE CRICKET, AND THE MOLE-CRICKET.

Belonging to the second order of insects, we find a tribe of little animals, which, though differing in size and colour, strongly resemble each other in figure, appetites, nature, and transformation. But though they all appear of one family, yet man has been taught to hold them in different estimation; for while some of this tribe amuse him with their chirpings, and banish solitude from the fields, others come in swarms, eat up every thing that is green, and in a single night convert the most delightful landscape into a dreary waste. However, if these animals be separately considered, the devouring locust is not in the least more mischievous than the musical grasshopper; the only difference is, that one species comes for food in a swarm, the other feeds singly.

That animal which is called the grasshopper with us, differs greatly from the cicada of antiquity; for as our insect is active enough in hopping through the long grass, from whence it has taken its name, the cicada had

not this power, but either walked or flew.[1] The little hissing note also of our grasshopper is very different from the song of the cicada, which was louder and far more musical. The manner in which this note is produced by the two animals is very different; for the cicada makes it by a kind of buckler, which the male has beneath its belly; the grasshopper by a

1 The *Cicada* is celebrated for its song, by the ancient Greek poets, under the name of Τεττιξ. The Romans called it *Cicada*, which we sometimes, but erroneously, translate "grasshopper;" for the grasshoppers belong to an entirely different order of insects. We shall, therefore, (says Mr Rennie) take the liberty of calling the Cicadæ, *Tree-hoppers*, to which the cuckoo-spit insect (*Tettigonia spumaria*, Oliv.) is allied; but there is only one of the true cicadæ hitherto ascertained to be British, namely, the *Cicada hæmatodes* (Linn.) which was taken in the New Forest, Hampshire, by Mr Daniel Bydder.

M. Reaumur was exceedingly anxious to study the economy of those insects; but they not being indigenous in the neighbourhood of Paris, he commissioned his friends to send him some from more southern latitudes, and he procured in this way specimens not only from the South of France and from Italy, but also from Egypt. From these specimens he has given the best account of them yet published; for though, as he tells us, he had never had the pleasure of seeing one of them alive, the more interesting parts of their structure can be studied as well in dead as in living specimens. We ourselves possess several specimens from New Holland, upon which we have verified some of the more interesting observations of Reaumur.

Virgil tells us, that in his time "the cicadæ burst the very shrubs with their querulous music;" but we may well suppose that he was altogether unacquainted with the singular instrument by means of which they can actually (not poetically) cut grooves in the branches they select for depositing their eggs. It is the male, as in the case of birds, which fills the woods with his song; while the female, though mute, is no less interesting to the naturalist on account of her curious ovipositor. This instrument, like all those with which insects are furnished by nature for cutting, notching, or piercing, is composed of a horny substance, and is also considerably larger than the size of the tree-hopper would proportionally indicate. It can on this account be partially examined without a microscope, being, in some of the larger species, no less than five lines * in length.

The ovipositor or auger *(tariere)* as Reaumur calls it, is lodged in a sheath which lies in a groove of the terminating ring of the belly. It requires only a very slight pressure to cause the instrument to protrude from its sheath, when it appears to the naked eye to be of an equal thickness throughout except at the point, where it is somewhat enlarged and angular, and on both sides finely indented with teeth. A more minute examination of the sheath demonstrates that it is composed of two horny pieces slightly curved, and ending in the form of an elongated spoon, the concave part of which is adapted to receive the convex end of the ovipositor.

When the protruded instrument is further examined with a microscope, the denticulations, nine in number on each side, appear strong, and arranged with great symmetry, increasing in fineness towards the point, where there are three or four very small ones, beside the nine that are more obvious. The magnifier also shows that the instrument itself, which appeared simple to the naked eye, is in fact composed of three different pieces, two exterior armed with the teeth before-mentioned, denominated by Reaumur files, *(limes)*, and another pointed like a lancet, and not denticulated. The denticulated pieces moreover are capable of being moved forwards and backwards, while the centre one remains stationary, and as this motion is effected by pressing a pin or the blade of a knife over the muscles on either side at the origin of the ovipositor, it may be presumed that those muscles are destined for producing similar movements when the insect requires them. By means of a finely pointed pin carefully introduced between the pieces, and pushed very gently downwards, they may be, with no great difficulty, separated in their whole extent.

* A line is about the twelfth part of an inch.

The contrivance by which those three pieces are held united, while at the same time the two files can be easily put in motion, are similar to some of our own mechanical inventions, with this difference, that no human workman could construct an instrument of this description so small, fine, exquisitely polished, and fitting so exactly. We should have been apt to form the grooves in the central piece, whereas they are scooped out in the handles of the files, and play upon two projecting ridges in the central piece, by which means this is rendered stronger. M. Reaumur discovered that the best manner of showing the play of this extraordinary instrument is to cut it off with a pair of scissors near its origin, and then, taking it between the thumb and the finger at the point of section, work it gently to put the files in motion.

Beside the muscles necessary for the movement of the files, the handle of each is terminated by a curve of the same hard horny substance as itself, which not only furnishes the muscles with a sort of lever, but serves to press, as with a spring, the two files close to the central piece, as is shown in the lower figure.

M. Pontedera, who studied the economy of the tree-hoppers with some care, was anxious to see the insect itself make use of the ovipositor in forming grooves in wood, but found that it was so shy and easily alarmed, that it took to flight whenever he approached; a circumstance of which Reaumur takes advantage to soothe his regret that the insects were not indigenous in his neighbourhood. But of their workmanship when completed, he had several specimens sent to him from Provence and Languedoc by the Marquis de Caumont.

The gall-flies, when about to deposit their eggs, select growing plants and trees; but the tree-hoppers, on the contrary, make choice of dead, dried branches, for the mother seems to be aware that moisture would injure her progeny. The branch, commonly a small one, in which eggs have been deposited, may be recognised by being covered with little oblong elevations caused by small splinters of the wood, detached at one end, but left fixed at the other by the insect. These elevations are for the most part in a line, rarely in a double line, nearly at equal distances from each other, and form a lid to a cavity in the wood about four lines in length, containing from four to ten eggs. It is to be remarked, that the insect always selects a branch of such dimensions, that it can get at the pith, not because the pith is more easily bored, for it does not penetrate into it at all, but to form a warm and safe bed for the eggs. M. Pontedera says, that when the eggs have been deposited, the insect closes the mouth of the hole with a gum capable of protecting them from the weather; but M. Reaumur thinks this only a fancy, as out of a great number which he examined, he could discover nothing of the kind. Neither is such a protection wanted; for the woody splinters above mentioned furnish a very good covering.

The grubs hatched from these eggs (of which, M. Pontedera says, one female will deposit from five to seven hundred) issue from the same holes through which the eggs have been introduced, and betake themselves to the ground to feed on the roots of plants. They are not transformed into chrysalides, but into active nymphs, remarkable for their fore limbs, which are thick, strong, and furnished with prongs for digging; and when we are

transparent membrane that covers a hole at the base of its wings. There is still a greater variety in all these with regard to shape and colour. Some are green, some black, some livid, and some variegated; but many of them do not show all their colours till they fly. Some have long legs, some short, some with more joints, others with fewer. Some sing, others are mute: some are innocent, doing no damage to the husbandman; while others do such prodigious mischief, that they are looked upon in some countries as one of the terrible scourges of the incensed Divinity.

Of this variegated tribe, the little grasshopper that breeds in such plenty in every meadow, and that continues its chirping through the summer, is best known to us; and by having its history, we shall be possessed of that of all the rest. This animal is of the colour of green leaves, except a line of brown which streaks the back, and two pale lines under the belly and behind the legs. It may be divided into the head, the corselet, and the belly. The head is oblong, regarding the earth, and bearing some resemblance to that of a horse. Its mouth is covered by a kind of round buckler jutting over it, and armed with teeth of a brown colour, hooked at the points. Within the mouth is perceivable a large reddish tongue, and fixed to the lower jaw. The feelers or horns are very long, tapering off to a point; and the eyes are like two black specks, a little prominent. The corselet is elevated, narrow, armed above and below by two serrated spines. The back is armed with a strong buckler, to which the muscles of the legs are firmly bound, and round these muscles are seen the vessels by which the animal breathes, as white as snow. The last pair of legs are much longer and stronger than the first two pair, fortified by thick muscles, and very well formed for leaping. It has four wings; the anterior one springing from the second pair of legs, the posterior from the third pair. The hinder wings are much finer and more expansive than the foremost, and are the principal instruments of its flight. The belly is considerably large, composed of eight rings, and terminated by a forky tail, covered with down, like the tail of a rat. When examined internally, besides the gullet, we discover a small stomach; and behind that a very large one, wrinkled and furrowed within side: lower down there is still a third; so that it is not without reason that all the animals of this order are said to chew the cud, as they so much resemble ruminant animals in their internal conformation.

A short time after the grasshopper assumes its wings, it fills the meadow with its note; which, like that among birds, is a call to courtship. The male only of this tribe is vocal; and, upon examining at the base of the wings, there will be found a little hole in its body, covered with a fine transparent membrane. This is thought, by Linnæus, to be the instrument it employs in singing: but others are of opinion the sound is produced by rubbing its hinder legs against each other: however this be, the note of one male is seldom heard, but it is returned by another; and the two little animals, after many mutual insults of this kind, are seen to meet and fight desperately. The female is generally the reward of victory; for, after the combat, the male seizes her with his teeth behind the neck, and thus keeps her for several hours till the business of fecundation is performed. They are at that time so strongly united, that they can scarcely be separated without tearing asunder. Towards the latter end of autumn the female prepares to deposit her burden; and her body is then seen greatly distended with her eggs, which she carries to the number of an hundred and fifty. In order to make a proper lodgment in the earth for them, Nature has furnished her with an instrument at her tail, somewhat resembling a two-edged sword, which she can sheathe and unsheathe at pleasure: with this she pierces the earth as deep as she is able; and into the hole which her instrument has made, she deposits her eggs, one after the other.

Having thus provided for the continuation of her posterity, the animal herself does not long survive; but as the winter approaches, she dries up, seems to feel the effects of age, and dies from total decay. Some, however, assert, that she is killed by the cold: and others, that she is eaten by worms: but certain it is, that neither the male nor female are ever seen to survive the winter. In the meantime the eggs which have been deposited continue unaltered, either by the severity of the season or the retardation of the spring. They are of an oval figure, white, and of the consistence of horn; their size nearly equals that of a grain of anise: they are enveloped in the body within a covering, branched all over with veins and arteries; and when excluded they crack, on being pressed between the fingers; their substance within is a whitish, viscous, and transparent fluid. In this manner they remain deposited beneath the surface of the earth during the whole winter; till the genial return of spring begins to vivify and hatch them. The sun, with its warmth, beginning to animate all nature, the insect eggs feel its benign influence; and generally, about the beginning of May, every egg produces an insect about the size of a flea. These, at first, are of a whitish colour; at the end of two or three days

told by Dr Le Fevre, that they make their way easily into hard stiff clay, to the depth of two or three feet, we perceive how necessary to them such a conformation must be.—*Insect Architecture.*

they turn black; and soon after they become of a reddish brown.

They appear, from the beginning, like grasshoppers, wanting wings; and hop among the grass, as soon as excluded, with great agility.

Yet still they are by no means arrived at their state of full perfection, although they bear a strong resemblance to the animal in its perfect form. They want, or seem to want, the wings, which they are at last seen to assume; and can only hop among the grass, without being able to fly. The wings, however, are not wanting, but are concealed within four little bunches, that seem to deform the sides of the animal: there they lie rolled up in a most curious manner; and occupying a smaller space than one could conceive who saw them extended. Indeed, all insects, whatever transmutations they seem to undergo, are yet brought forth with those very limbs, parts, and wings, which they afterwards seem to acquire. In the most helpless caterpillar there is still to be seen the rudiments of that beautiful plumage which it afterwards expands when a butterfly: and though many new parts seem unfolded to the view, the animal acquires none but such as it was from the beginning possessed of. The grasshopper, therefore, though seemingly without wings, is, in reality, from the first, possessed of those instruments, and only waits for sufficient force to break the bonds that hold them folded up, and to give them their full expansion.

The grasshopper, that, for above twenty days from its exclusion, has continued without the use of its wings, which were folded up to its body, at length prepares for its emancipation, and for a life of greater liberty and pleasure. To make the proper dispositions for the approaching change, it ceases from its grassy food, and seeks about for a convenient place beneath some thorn or thistle, that may protect it from an accidental shower. The same laborious writhings and workings, heavings and palpitations, which we have remarked in every other insect upon an approaching change, are exhibited in this. It swells up its head and neck; it then seems to draw them in again; and thus alternately, for some time it exerts its powers to get free. At length, the skin covering the head and breast is seen dividing above the neck; the head is seen issuing out first from the bursting skin; the efforts still continuing, the other parts follow successively; so that the little animal, with its long feelers, legs and all, works its way from the old skin, that remains fixed to the thistle or the thorn. It is, indeed, inconceivable how the insect can thus extricate itself from so exact a sheath as that which covereth every part of its body.[1]

The grasshopper, thus disengaged from its outer skin, appears in its perfect form; but then so feeble, and its body so soft and tender, that it may be moulded like wax. It is no longer of that obscure colour which it exhibited before, but of a greenish white, which becomes more vivid as the moisture on the surface is dried away. Still, however, the animal continues to show no signs of life, but appears quite spent and fatigued with its labour for more than an hour together. During this time, the body is drying, and the wings unfolding to their greatest expansion; and the curious observer will perceive them, fold after fold, opening to the sun, till at last they become longer than the two hinder legs. The insect's body also is lengthened during this operation, and it becomes much more beautiful than before.

These insects are generally vocal in the midst of summer, and they are heard at sunsetting much louder than during the heats of the day. They are fed upon grass; and, if their belly be pressed, they will be seen to return the juices of the plants they have last fed upon. Though unwilling to fly, and slow in flight, particularly when the weather is moist or cool, they are sometimes seen to fly to considerable distances. If they are caught by one of the hinder legs, they quickly disengage themselves from it, and leave the leg behind them. This, however, does not grow again, as with crabs or spiders; for as they are animals but of a single year's continuance, they have not sufficient time for repairing those accidental misfortunes. The loss of their leg also prevents them from flying; for being unable to lift themselves in the air, they have not room upon the ground for the proper expansion of their wings. If they be handled roughly, they will bite very fiercely; and when they fly, they make a noise with their wings. They generally keep in the plain, where the grass

[1] A curious circumstance regarding the grasshopper is related in the *American Quarterly Review*. The large winged grasshopper, which flutters with so much vivacity through our meadows during the autumn, feeds upon vegetable matter, and deposits its eggs upon vegetables, for the purpose of being supported until matured. Before the grasshopper takes wing another insect, the ichneumon, lights upon its body, and thrusts under its skin a number of its eggs, by means of a tubular awl-shaped oviduct. Those eggs slowly acquire perfection, become living worms, and feed upon the body of the hapless grasshopper, until themselves are ready to take wing. So admirably do they perform their office, that they do not injure the vital organs of the insect they are internally devouring, until they are just ready to change their state: and at the proper season, hundreds of grasshoppers, in this condition, have just strength enough remaining to flutter to a tree or fence, and with a dying effort fix their hooked feet so firmly as to retain their position long after death. Examine their bodies at this season, and you will find an empty shell or one filled with large and active worms, just ready to burst their coverings and become winged insects.

is luxuriant, and the ground rich and fertile: there they deposit their eggs, particularly in those cracks which are formed by the heat of the sun.

Such are the habits and nature of those little vocal insects that swarm in our meadows, and enliven the landscape. The larger kinds only differ from them in size, in rapidity of flight, and the powers of injuring mankind, by swarming upon the productions of the earth. The quantity of grass which a few grasshoppers that sport in the fields can destroy is trifling; but when a swarm of locusts, two or three miles long, and several yards deep, settle upon a field, the consequences are frightful. The annals of every country are marked with the devastation which such a multitude of insects produces; and though they seldom visit Europe in such dangerous swarms as formerly, yet, in some of the southern kingdoms, they are still formidable. Those which have, at uncertain intervals, visited Europe, in our memory, are supposed to have come from Africa, and the animal is called the Great Brown Locust. It was seen in several parts of England in the year 1748, and many dreadful consequences were apprehended from its appearance. This insect is about three inches long; and has two horns or feelers, an inch in length. The head and horns are of a brownish colour; it is blue about the mouth, as also on the inside of the larger legs. The shield that covers the back is greenish; and the upper side of the body brown, spotted with black, and the under side purple. The upper wings are brown, with small dusky spots, with one larger at the tips; the under wings are more transparent, and of a light brown, tinctured with green, but there is a dark cloud of spots near the tips. This is that insect that has threatened us so often with its visitations; and that is so truly terrible in the countries where it is bred. There is no animal in the creation that multiplies so fast as these, if the sun be warm, and the soil in which their eggs are deposited be dry. Happily for us, the coldness of our climate, and the humidity of our soil, are no way favourable to their production; and as they are but the animals of a year, they visit us and perish.

The Scripture, which was written in a country where the locust made a distinguished feature in the picture of nature, has given us several very striking images of this animal's numbers and rapacity. It compares an army, where the numbers are almost infinite, to a swarm of locusts: it describes them as rising out of the earth, where they are produced; as pursuing a settled march to destroy the fruits of the earth, and co-operate with divine indignation.

When the locusts take the field, as we are assured, they have a leader at their head, whose flight they observe, and pay a strict attention to all his motions. They appear, at a distance, like a black cloud, which, as it approaches, gathers upon the horizon, and almost hides the light of the day. It often happens that the husbandman sees this imminent calamity pass away without doing him any mischief; and the whole swarm proceeds onward, to settle upon the labours of some less fortunate country. But wretched is the district upon which they settle: they ravage the meadow and the pasture ground; strip the trees of their leaves, and the garden of its beauty: the visitation of a few minutes destroys the expectations of a year; and a famine but too frequently ensues. In their native tropical climates they are not so dreadful as in the more southern parts of Europe. There, though the plain and the forest be stripped of their verdure, the power of vegetation is so great, that an interval of two or three days repairs the calamity: but our verdure is the livery of a season; and we must wait till the ensuing spring repairs the damage. Besides, in their long flights to this part of the world, they are famished by the tediousness of their journey, and are, therefore, more voracious wherever they happen to settle. But it is not by what they devour that they do so much damage as by what they destroy. Their very bite is thought to contaminate the plant, and to prevent its vegetation. To use the expression of the husbandman, they burn whatever they touch, and leave the marks of their devastation for two or three years ensuing. But if they be noxious while living, they are still more so when dead; for wherever they fall, they infect the air in such a manner, that the smell is unsupportable. Orosius tells us, that, in the year of the world 3800, there was an incredible number of locusts which infected Africa; and, after having eaten up every thing that was green, they flew off, and were drowned in the African sea: where they caused such a stench, that the putrefying bodies of hundreds of thousands of men could not equal it.

In the year 1690, a cloud of locusts was seen to enter Russia in three different places; and from thence to spread themselves over Poland and Lithuania, in such astonishing multitudes, that the air was darkened, and the earth covered with their numbers. In some places they were seen lying dead, heaped upon each other four feet deep; in others, they covered the surface like a black cloth: the trees bent beneath their weight; and the damage which the country sustained exceeded computation. In Barbary their numbers are formidable, and their visits are frequent. In the year 1724, Dr Shaw was a witness, in that country, of their devastations. Their first ap-

pearance was about the latter end of March, when the wind had been southerly for some time. In the beginning of April, their numbers were so vastly increased, that, in the heat of the day they formed themselves into large swarms, which appeared like clouds, and darkened the sun. In the middle of May they began to disappear, retiring into the plains to deposit their eggs. In the next month, being June, the young brood began to make their appearance, forming many compact bodies of several hundred yards square; which afterwards marching forward, climbed the trees, walls, and houses, eating every thing that was green in their way. The inhabitants, to stop their progress, laid trenches all over their fields and gardens, filling them with water. Some placed large quantities of heath, stubble, and such like combustible matter, in rows, and set them on fire on the approach of the locusts. But all this was to no purpose; for the trenches were quickly filled up, and the fires put out by the vast number of swarms that succeeded each other. A day or two after one of these was in motion, others that were just hatched came to glean after them, gnawing off the young branches and the very bark of the trees. Having lived near a month in this manner, they arrived at their full growth, and threw off their worm-like state, by casting their skins. To prepare themselves for this change, they fixed their hinder feet to some bush or twig, or corner of a stone, when immediately, by an undulating motion used on this occasion, their heads would first appear, and soon after the rest of their bodies. The whole transformation was performed in seven or eight minutes' time; after which, they were a little while in a languishing condition; but as soon as the sun and air had hardened their wings, and dried up the moisture that remained after casting off their sloughs, they returned again to their former greediness, with an addition both of strength and agility. But they did not continue long in this state before they were entirely dispersed; after laying their eggs, directing their course northward, they probably perished in the sea. It is said that the holes these animals make, to deposit their eggs, are four feet deep in the ground; the eggs are about fourscore in number, of the size of caraway comforts, and bundled up together in clusters.[1]

It would be endless to recount all the mischiefs which these famished insects have at different times occasioned; but what can have induced them to take such distant flights, when

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[1] *The Locust.*—Dr Clarke, in his Travels in Tartary, on approaching Cuffa, thus notices the number of locusts: "We now began to perceive the truth of those surprising relations which we had often heard and read concerning the locust in countries infested with that insect. The *steppes* were entirely covered by their bodies; and their numbers falling, resembled flakes of snow, carried obliquely by the wind, and spreading a thick mist over the sun. Myriads fell over the carriage, the horses, and the drivers. The stories of these animals, told us by the Tartars, were more marvellous than any we had before heard. They said that instances had occurred of persons being suffocated by a fall of locusts in the *steppes*. It was now the season, they further added, in which their numbers began to diminish. When they first make their appearance, a thick dark cloud is seen very high in the air, which, as it passes, obscures the sun. I had always supposed the stories of the locust to exaggerate their real appearance; but found their swarms so astonishing in all the *steppes* over which we passed in this part of our journey, that the whole face of nature might have been described as concealed by a living veil. They were of two kinds; the *gryllus Tartaricus*, and the *gryllus migratorius*, or common migratory locust. The first is almost twice the size of the second, and since it precedes the other, bears the name of the herald or messenger. The migratory locust has red legs, and its inferior wings have a lively red colour, which gives a bright fiery appearance to the animal when fluttering in the sun's rays. The strength of limbs possessed by it is amazing: when pressed down by the hand upon a table, it has almost power to raise the fingers; but this force resides wholly in the legs; for if one of these be broken off, which happens by the slightest accident, the power of action ceases. There is yet a third variety of locust, *gryllus viridissimus* of Linnæus, found near the Don and the Kuban, which is entirely of a green colour. This last I have since seen upon the banks of the Cam in my own country, and felt for the moment intimidated, lest such a presage should be the herald of the dreadful scourge which the locust bears wherever it abounds. On whatever spot these animals fall, the whole vegetable produce disappears. Nothing escapes them, from the leaves of the forest to the herbs of the plain. Fields, vineyards, gardens, pastures, everything is laid waste; and sometimes the only appearance left upon the naked soil is a disgusting superficies caused by their putrefying bodies, the stench of which is sufficient to breed a pestilence."

Ravages of Locusts.—When Captains Irby and Mangles were travelling round the southern extremity of the Dead Sea, in the end of May, they had an opportunity of observing these insect depredators. "In the morning," say they, "we quitted Shobek. On our way we passed a swarm of locusts that were resting themselves in a gully; they were in sufficient numbers to alter apparently the colour of the rock on which they had alighted, and to make a sort of crackling noise while eating, which we heard before we reached them. Volney compares it to the foraging of an army. Our conductors told us they were on their way to Gaza, and that they pass almost annually."

Even our own island has been alarmed by the appearance of locusts, a considerable number having visited us in 1748; but they happily perished without propagating. Other parts of Europe have not been so fortunate. They have frequently come also from Africa into Italy and Spain. In the year 591 an infinite army of locusts, of a size unusually large, ravaged a considerable part of Italy, and being at last cast into the sea, (as seems for the most part to be their fate,) a pestilence, it is alleged, arose from their stench, which carried off nearly a million of men and beasts. In the Venetian territory, likewise, in 1478, more than 30,000 persons are said to have perished in a famine chiefly occasioned by the depredations of locusts.—*Insect Transformation.*

Mode of Dispersing Locusts.—We traversed the grand *steppe* or desert of Astrakhan for two days. On the evening of the 1st of August, we arrived at a Russian village, which was surrounded by a considerable tract

they come into Europe, is not easy to be accounted for. It seems most probable, that, by means of a very dry season, in the heart of Africa, they are propagated in such numbers, that the vegetables of the spot where they are produced are not sufficient to sustain them. Thus being obliged to find out other countries, they traverse the sandy deserts, where they can find no sustenance: still meeting with nothing to allure them from their height, they proceed forward across the sea, and thus come into Europe, where they alight upon the first green pastures that occur.

In some parts of the world the inhabitants turn what seems a plague to their own advantage. Locusts are eaten by the natives in many kingdoms of the East; and are caught in small nets provided for that purpose. They parch them over the fire in an earthen pan; and when their wings and legs are fallen off, they turn reddish, of the colour of boiled shrimps. Dampier has eaten them thus prepared, and thinks them a tolerable dish. The natives of Barbary also eat them fried with salt; and they are said to taste like cray-fish.

There is a locust in Tonquin, about the bigness of the top of a man's finger, and as long as the first joint. It breeds in the earth, in low grounds; and in the months of January and February, which is the season for taking them, they issue from the earth in vast swarms. At first they can hardly fly, so that they often fall into the rivers in great numbers: however, the natives in these months watch the rivers, and take them up in multitudes in small nets. They either eat them fresh, broiled on the coals, or pickle them for keeping. They are considered as a great delicacy in that part of the world, as well by the rich as the poor. In the countries where they are eaten, they are regularly brought to market, and sold as larks or quails in Europe. They must have been a common food with the Jews, as Moses, in the book of Leviticus, permits them to eat four different kinds of this animal, which he takes care to specify. This dish, however, has not yet made its way into the kitchens of the luxurious in Europe; and though we may admire the delicacies of the East, we are as yet happily deprived of the power of imitation.

Of all animals, however, of this noxious tribe, the Great West Indian Locust, individually considered, is the most formidable. It is about the thickness of the barrel of a goose-quill, and the body is divided into nine or ten joints; in the whole, about six or seven inches long. It has two small eyes standing out of the head, like those of crabs; and two feelers, like long hair. The whole body is studded with small excrescences, which are not much bigger than the points of pins. The shape is roundish, and the body diminishes in circumference to the tail, which is forked into two horns. Between this, there is a sort of a sheath containing a small dangerous sting. If any person happens to touch this insect, he is sure to be stung; and is immediately taken with a shivering and trembling all over the body; which, however, may soon be put a stop to, by rubbing the place that was affected with a little palm oil.[1]

From the locust we descend to the Cricket, which is a very inoffensive and pretty animal. Though there be a species of this insect that lives entirely in the woods and fields, yet that with which we are best acquainted is the House-cricket, whose voice is so well known behind a country fire in a winter's evening. There is something so unusual in hearing a sound while we do not see the animal producing it, nor discover the place from whence it comes, that, among the country people, the chirping of the cricket is always held ominous; and whether it deserts the fire-side, or pays an unexpected visit, the credulous peasantry always find something to be afraid of. In general, however, the killing of a cricket is considered as a most unlucky omen: and though their company is not much desired, yet no methods must be taken to remove them.[2]

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of well-cultivated land. While changing horses, I witnessed what was to me a very curious sight—a vast flight of locusts, extending fifteen miles, suddenly made their appearance from the east, and came in a huge phalanx to attack the crops. In an instant every villager was on the road to his own field. Some took dogs, others were on horseback, and others ran shouting and clapping their hands all the way, the inhabitants finding from experience that the locusts very much dislike noise. My fellow-traveller told me, that in the colony of Karass, when the locusts come in sight, not only all the inhabitants, but the military turn out, and endeavour to drive them off, by drums and fifes, and a perpetual discharge of musketry. The enemy, thus repulsed, make a speedy retreat and commit their depredations on the land of those who are less on the alert to resist them.—*Captain Keppel's Travels.*

[1] It is now known that every insect of this tribe is perfectly harmless.

[2] *The Cricket.*—While many other insects must be sought after in fields, and woods, and waters, the *gryllus domesticus*, or house-cricket, resides altogether within our dwellings, intruding itself upon our notice whether we will or not. This species delights in new-built houses, being, like the spider, pleased with the moisture of the walls; and, besides, the softness of the mortar enables them to burrow and mine between the joints of the bricks or stones, and to open communications from one room to another. They are particularly fond of kitchens and bakers' ovens, on account of their perpetual warmth.

Tender insects that live abroad either enjoy only the short period of one summer, or else doze away the cold uncomfortable months in profound slumbers; but these, residing as it were in a torrid zone, are always alert and merry; a good Christmas fire is to them like the heats of the dog-days. Though they are frequently heard by day, yet is their natural time of motion only in the night. As soon as it grows dusk, the chirping increases, and they come running forth, and are from the size of a flea

The cricket very much resembles the grasshopper in its shape, its manner of ruminating, its voice, its leaping, and methods of propagation. It differs in its colour, which is uniformly of a rusty brown; in its food, which is more various; and in its place of residence, which is most usually in the warmest chinks behind a country hearth. They are in some measure obliged to the bad masonry employed in making peasants' houses for their retreats. The smallest chink serves to give them shelter; and where they once make their abode they are sure to propagate. They are of a most chilly nature, seldom leaving the fireside: and, if undisturbed, are seen to hop from their retreats to chirrup at the blaze in the chimney. The wood-cricket is the most timorous animal in nature; but the chimney-cricket, being used to noises, disregards not only those, but the appearance of people near it. Whether the voice of this animal is formed in the same manner with that of the grasshopper, by a fine membrane at the base of the wings, which is moved by a muscle, and which being coiled up, gives a sound like a quail-pipe, is not yet ascertained; nor do we well know the use of this voice, since anatomical inspection has not yet been able to discover the smallest organs of hearing. Still, however, we can make no doubt of their power of distinguishing sounds, though probably not in the same manner with the more perfect ranks of nature. Certain it is, that I have often heard them call, and this call was as regularly answered by another, although none but the males are vocal.

As the cricket lives chiefly in the dark, so its eyes seem formed for the gloominess of its abode; and those who would surprise it, have only to light a candle unexpectedly; by which it is dazzled, and cannot find the way back to its retreat. It is a very voracious little animal, and will eat bread, flour, and meat; but it is particularly fond of sugar. They never drink, but keep for months together at the back of the chimney, where they could possibly have had no moisture. The warmth of their situation only serves to increase their mirth and loquacity. Except in the very coldest weather, they never cease their chirruping, but continue that little piercing note, which is as pleasing to some as it is disagreeable to others. The great Scaliger was particularly delighted with the chirruping of crickets, and kept several of them for his amusement, enclosed in a box, which he placed in a warm situation. Others, on the contrary, think there is something ominous and melancholy in the sound, and use every endeavour to banish this insect from their houses. Ledelius tells us of a woman who was very much incommoded by crickets, and tried, but in vain, every method of banishing them from her house. She at last accidentally succeeded; for having one day invited several guests to her house, where there was a wedding, in order to increase the festivity of the entertainment, she procured drums and trumpets to entertain them. The noise of these was so much greater than what the little animals were used to, that they instantly forsook their situation, and were never heard in that mansion more.

But of all the cricket kind, that which is called the *Mole Cricket* is the most extraordinary. This animal is the largest of all the insects with which we are acquainted in this country, being two inches and a half in length, and three quarters of an inch in breadth. The colour is of a dusky brown; and at the extremity of the tail there are two hairy excrescences, resembling, in some sense, the tail of a mouse. The body consists of eight scaly joints, or separate folds; is brown on the upper part, and more deeply tinged below. The wings are long, narrow, and terminate in a sharp point, each having a blackish line running down it: however, when they are extended, they appear to be much broader than could at

to that of their full stature. As one should suppose, from the burning atmosphere which they inhabit, they are a thirsty race, and show a great propensity for liquids, being found frequently drowned in pans of water, milk, broth, or the like. Whatever is moist they affect; and, therefore, often gnaw holes in wet woollen stockings and aprons that are hung to the fire; they are the housewife's barometer, foretelling her when it will rain; and are prognostics sometimes, she thinks, of ill or good luck; of the death of a near relation, or the approach of an absent lover. By being the constant companions of her solitary hours, they naturally become the objects of her superstition. These crickets are not only very thirsty, but very voracious; for they will eat the scummings of pots, and yeast, salt, crumbs of bread, and any kitchen offal or sweepings. In the summer we have observed them to fly, when it became dusk, out of the windows, and over the neighbouring roofs. This feat of activity accounts for the sudden manner in which they often leave their haunts, as it does for the method by which they come to houses where they were not known before. It is remarkable, that many sorts of insects seem never to use their wings but when they have a mind to shift their quarters and settle new colonies. When in the air, they move *volatu undoso*, in waves, or curves, like woodpeckers, opening and shutting their wings at every stroke, and so are always rising or sinking.

When they increase to a great degree, as they did once in the house where I am now writing, they become noisome pests, flying into the candles, and dashing into people's faces; but may be blasted and destroyed by gunpowder discharged into their crevices and crannies. In families, at such times, they are, like Pharaoh's plague of frogs, "in their bed-chambers, and upon their beds, and in their ovens, and in their kneading-troughs." Their shrilling noise is occasioned by a brisk attrition of their wings. Cats catch hearth-crickets, and, playing with them as they do with mice, devour them. Crickets may be destroyed, like wasps, by phials half filled with beer, or any liquid, set in their haunts; for, being always eager to drink, they will crowd in till the bottles are full.—*Natural History of Selborne.*

first sight be supposed. The shield of the breast is of a firm texture, of a blackish colour, and hairy. The fore-feet, which are this animal's principal instruments of burrowing in the earth, are strong, webbed, and hairy; it generally, however, runs backward; but it is commonly under ground, where it burrows even faster than a mole. It is thought also to be amphibious, and capable of living under water, as well as under ground.

Of all insects this is the most detested by gardeners, as it chiefly resides in that ground which lies light, and where it finds sufficient plenty under the surface. Thus, in a single night's time, it will run along a furrow, which has been newly sown, and rob it of all its contents. Its legs are formed in such a manner that it can penetrate the earth in every direction; before, behind, and above it. At night it ventures from its under-ground habitation, and, like the cricket, has its chirping call. When the female is fecundated, she makes a cell of clammy earth, the inside of which is large enough to hold two hazel-nuts; and in this she lays her eggs. The whole nest is about the size of a common hen's egg, closed up on every side, and well defended from the smallest breath of air. The eggs generally amount to the number of a hundred and fifty, being white, and about the size of a caraway comfort. They are thus carefully covered, as well to defend them from the injuries of the weather, as from the attacks of the black-beetle; that being itself an under-ground inhabitant, would, but for this precaution, devour or destroy them. To prevent this, the female mole-cricket is often posted as a sentinel near the nest; and when the black invader plunges in to seize its prey, the guardian insect seizes him behind, and instantly bites him in two.[1]

Nothing can exceed the care and assiduity which these animals exhibit in the preservation of their young. Wherever the nest is placed, there seems to be a fortification, avenues, and entrenchments drawn round it: there are numberless winding-ways that lead to it, and a ditch drawn about it, which few of its insect enemies are able to pass. But their care is not confined to this only; for at the approach of winter they carry their nest entirely away, and sink it deeper in the ground, so that the frost can have no influence in retarding the young brood from coming to maturity. As the weather grows milder, they raise their magazine in proportion; till, at last, they bring it as near the surface as they can, to receive the genial influence of the sun, without wholly exposing it to view; yet should the frost unexpectedly return, they sink it again as before.

[1] Among this tribe may be numbered the *great Lantern Fly of Peru*, an insect the most splendid and luminous of all that are yet known. In the head is contained a phosphorescent light, sufficiently vivid to serve the purposes of a candle in a dark room; or, when two or three are put together at the end of a stick, to light travellers on the road like a lantern. It is about the size of a larger kind of locust, and the wings and whole body are beautifully variegated.

CHAP. V.

OF THE EARWIG, THE FROTH INSECT, AND SOME OTHERS BELONGING TO THE SECOND ORDER OF INSECTS.

We should still keep in memory, that all insects, of the second order, though not produced quite perfect from the egg, yet want very little of their perfection, and require but a very small change to arrive at that state which fits them for flight and generation. The natural functions in these are never suspended: from the instant they leave the egg, they continue to eat, to move, to leap, and pursue their prey: a slight change ensues; a skin, that inclosed a part of their body and limbs, bursts behind, like a woman's stays, and gives freedom to a set of wings, with which the animal expatiates, and flies in pursuit of its mate.

Of all this class of insects, the earwig[2] undergoes the smallest change. This animal is so common, that it scarce needs a description: its swiftness in the reptile state is not less remarkable than its indefatigable velocity when upon the wing. That it must be very prolific, appears from its numbers; and that it is very harmless, every one's experience can readily testify. It is provided with six feet, and two feelers; the tail is forked; and with this it often attempts to defend itself against every

[2] *The Earwig.*—The name of this insect, in almost all European languages, has given it a character which causes a feeling of alarm even at the sight of it. Whether or not they ever did enter the human ear is doubtful, —that they might endeavour to do so, under the influence of fear, is more than probable; and this, perhaps, has been the origin of their name, and the universal prejudice against them. As it is said that anatomists deny the possibility of their deep or dangerous entrance into the ear, it is a pity that this is not generally known, as it might defend the constitutionally timid from unnecessary alarm, and give a more favourable idea of a part of animal creation, which forms a most necessary link in the chain of being.—*Brande's Journal.*

The great dread of the Ear-wig entering the ear is a popular error, whence, indeed, the animal derives its trivial name. Like many other insects, it enters any cavity in search of food or shelter; and it may, like them, enter the human ear as well as any other hole or hollow, but that it has a special predilection for that situation is a mistaken notion respecting the habits of the Forficula. —"*Miscellaneous Memoranda*" *in Notes on Nets, by the Hon. and Rev. C. Bathurst.*

assailant. But its attempts are only the threats of impotence; they draw down the resentment of powerful animals, but no way serve to defend it. The deformity of its figure, and its slender make, have also subjected it to an imputation, which though entirely founded in prejudice, has more than once procured its destruction. It is supposed, as the name imports, that it often enters into the ears of people sleeping; thus causing madness from the intolerable pain, and soon after death itself. Indeed, the French name which signifies the Ear-piercer, urges the calumny against the harmless insect in very plain terms; yet nothing can be more unjust: the ear is already filled with a substance which prevents any insect from entering; and besides, it is well lined and defended with membranes, which would keep out any little animal, even though the ear-wax were away. These reproaches, therefore, are entirely groundless: but it were well if the accusations which gardeners bring against the earwig were as slightly founded. There is nothing more certain than that it lives among flowers, and destroys them. When fruit also has been wounded by flies, the earwig generally comes in for a second feast, and sucks those juices which they first began to broach. Still, however, this insect is not so noxious as it would seem; and seldom is found but where the mischief has been originally begun by others. Like all of this class, the earwig is hatched from an egg. As there are various kinds of this animal, so they choose different places to breed in: in general, however, they lay their eggs under the bark of plants, or in the clefts of trees, when beginning to decay. They proceed from the egg in that reptile state in which they are most commonly seen; and as they grow larger, the wings bound under the skin begin to bourgeon. It is amazing how very little room four large wings take up before they are protruded; for no person could ever conceive such an expansion of natural drapery could be rolled up in so small a packet. The sheath in which they are enveloped, folds and covers them so neatly, that the animal seems quite destitute of wings;[1] and even when they are burst from their confinement, the animal, by the power of the muscles and joints which it has in the middle of its wings, can closely fold them into a very narrow compass. When the earwig has become a winged insect, it flies in pursuit of the female, ceasing to feed, and is wholly employed in the business of propagation. It lives in its winged state but a few days; and having taken care for the continuance of posterity, dries up, and dies to all appearance consumptive.[2]

To this order of insects we may also refer the Cuckoo Spit, or Froth Worm, that is often found hid in that frothy matter which we find on the surface of plants. It has an oblong obtuse body; and a large head with small eyes. The external wings, for it has four, are of a dusky brown, marked with two white spots: the head is black. The spume in which it is found wallowing is all of its own formation, and very much resembles frothy spittle. It proceeds from the vent of the animal, and other parts of the body; and if it be wiped away, a new quantity will be quickly seen ejected from the little animal's body. Within this spume it is seen in time to acquire four tubercles on its back, wherein the wings are enclosed: these bursting, from a reptile it becomes a winged animal; and thus rendered perfect, it flies to meet its mate, and propagate its kind.

The Water Tipula also belongs to this class. It has an oblong slender body, with four feet fixed upon the breast, and four feelers near the mouth. It has four weak wings, which do not at all seem proper for flying, but leaping only. But what this insect chiefly demands our attention for, is the wonderful lightness wherewith it runs on the surface of the water, so as scarce to put it in motion. It is sometimes seen in rivers, and on their banks, especially under shady trees; and generally in swarms of several together.

The Common Water-fly also breeds in the same manner with those above mentioned. This animal is by some called Notonecta, because it does not swim, in the usual manner, upon its belly, but on its back: nor can we help admiring that fitness in this insect for its situation, as it feeds on the under-side of plants which grow on the surface of the water; and therefore it is thus formed with its mouth upwards, to take its food with greater convenience and ease.

We may also add the Water-Scorpion, which is a large insect, being near an inch in length, and about half an inch in breadth. Its body is nearly oval, but very flat and thin; and its tail long and pointed. The head is small; and the feelers appear like legs, resembling the claws of a scorpion, but without sharp points. This insect is generally found in ponds; and is, of all others, the most tyrannical and rapacious. It destroys, like a wolf among sheep, twenty times as many as its hunger requires. One of these, when put into a basin of water, in which were thirty or forty worms of the libellula kind, each as large as itself, destroyed them all in a few minutes; getting on their backs, and piercing with its trunk through their body. These animals,

[1] Swammerdam, p. 114.

[2] The indefatigable M. de Geer has discovered that the female earwig sits over her eggs, and fosters her young, in the same manner as a hen does her chickens.

however, though so formidable to others, are nevertheless themselves greatly overrun with a little kind of louse, about the size of a nit, which very probably repays the injury which the water-scorpion inflicts upon others.

The water-scorpions live in the water by day: out of which they rise, in the dusk of the evening, into the air, and so flying from place to place often betake themselves, in quest of food, to other waters. The insect, before its wings are grown, remains in the place where it was produced; but when come to its state of perfection, sallies forth in search of a companion of the other sex, in order to continue its noxious posterity.

CHAP. VI.

OF THE EPHEMERA.[1]

The last insect we shall add to the second order is the Ephemera; which, though not strictly belonging to it, yet seems more properly referred to this rank than any other. Indeed, we must not attend to the rigour of method in a history where Nature seems to take delight to sport in variety.

That there should be a tribe of flies whose duration extends but to a day, seems, at first, surprising; but the wonder will increase, when we are told, that some of this kind seem to be born and to die in a space of a single hour. The reptile, however, from which they are bred, is by no means so short-lived; but is sometimes seen to live two years, and many times three years together.

All ephemeras, of which there are various

[1] *Ephemera.*—There are many species of these insects, some larger and some smaller, some longer-lived and some shorter, but as few of them live to behold the rising and the setting sun, they are all called *ephemera*, or "things of a day," their name is used to express all things that are very fleeting.

In autumn any one who walks by the water-side when the air is still, especially towards morning or evening, may catch them by thousands. They have four-wings, of a beautiful transparent membrane or film, spread out upon a fine net-work, of a substance very similar to horn. These fibres in the wings are called *nerves*, and the insects which have such wings are by naturalists called *neuroptera*, which is the Greek for "nerve-winged;" but these are not nerves. Nerves are understood to be organs of feeling or sensation; whereas, the fibres in the wings of those insects, merely support the membrane, just as the arm-frames of a windmill, or the masts and yards of a ship, support the canvas.

The eggs of the day-flies are all laid in the water, and hatched there; so that they so far partake of the nature of the eggs, or race of fishes, that they "come into active life," in less heat than land eggs, and do not need any *incubation*, or sitting, of the mother. Each female lays from 700 to 800, and she does it in less time than it takes to speak the words. The eggs are expelled in two portions, one of each at a time; but so fast, that the eggs seem two little knotted rods; but they separate and sink to the bottom undiscovered by the keen eyes of the fish. The female instantly dies, exhausted by the effort, which appears to be the only labour of her winged state of existence; if, indeed, she is not captured in the midst of her maternal duty by some darting fish, or skimming swallow; both of which prey upon countless thousands of the day-flies. When the fly lights to deposit her eggs, she raises her wings over her back, till they are nearly touching; and, at the same time, she elevates the hinder part of her body, and erects the three *setæ*, or bristles, in which it terminates. The wings and these bristles support her so that she barely touches the water, and so rises and falls with the ripple.

The moment that the females are in a condition to lay their eggs, they hasten to the waters, so that they are not so often seen as the males, whose only occupation is to sport in the air, in the neighbourhood of the cradle of their future offspring. Of these the little day-fly, which is born after dawn, produces her eight hundred, and is dead and gone, before the first gleam of the sun breaks over the eastern hill!

How long the eggs remain in the water before they are hatched, is not known; but possibly it varies with the season and the weather. The *larvæ* or young, in their first state, not only burrow, or make holes in the mud, but live on it; they are consequently not so numerous in sand and gravel as in places that are fat and oozy.

In summer the ponds, brooks, and ditches, are full of these larvæ, and so are water tanks, cisterns, and butts, if they are not kept clean. They (with the larvæ of other species) are among the chief summer impurities in the water at London and other places. If the water is not settled, they *may* come from the river; but the mud and sediment will enable them to breed in vessels, and the parent flies are every where. In themselves they are not unwholesome,—and, as they are alive, *they* cannot render the water putrid. The mud that breeds them, *is* putrid, however, as it contains dead animal and vegetable matter; and thus, though the young flies are not in themselves unwholesome, they are accompanied by substances that are so.

The larvæ remain in the mud two or three years; but in that they probably vary. The banks of rivers, in some parts of the continent, are so full of them, that to the depth of some inches, they actually contain more living matter than dead. They are all, however, lower than the surface of the water, and they breathe water, like fishes, by means of little gills on their sides. At length they attain their full size, and change into *nymphæ*, which are not unlike the larvæ, only they have wings folded up under their coats, of which they still have two, and must get out of both before they appear as flies.

The time that they remain nymphs is uncertain, and must vary, as the weather is one element in bringing about their last change. When that is to take place, they come out of the water, in vast numbers, and leave their old coats so abundant as to cover the water like a scum. After a little while they cast their inner coat; their wings stretch and become firm, and they mount into the air, to spend the hour, or the day, which is to them the whole period of air-breathing life.

That period is short; but that is necessary: for, in some places, if they were to live long, there would absolutely not be room for them. They eat nothing, and so destroy nothing; but there are places in France and Germany where, if they lived but for a month on the wing, they would build up the air solid to the tops of the trees. As it is, they sometimes fall on the ground near the rivers in showers like snow, and the people collect them in heaps as manure to the fields.

kinds are produced from the egg in the form of worms; from whence they change into a more perfect form; namely, that of aurelias, which is a kind of middle state between a worm and a fly; and from thence they take their last mutation, which is into a beautiful fly, of longer or shorter duration, according to its kind.

The ephemera, in its fly state, is a very beautiful-winged insect, and has a strong similitude to the butterfly, both from its shape and its wings. It is about the size of a middling butterfly; but its wings differ in not being covered with the painted dust with which those of butterflies are adorned, and rendered opaque, for they are very transparent, and very thin. These insects have four wings, the uppermost of which are much the largest; when the insect is at rest, it generally lays its wings one over the other, on the back. The body is long, being formed of six rings, that are larger at the origin than near the extremity; and from this a tail proceeds, that is longer than all the rest of the fly, and consists sometimes of three threads of an equal length, or sometimes of two long and one short. To acquire this beautiful form, the insect has been obliged to undergo several transmutations: but its glory is very short-lived, for the hour of its perfection is the hour of its death; and it seems scarcely introduced to pleasure, when it is obliged to part with life.

The reptile that is to become a fly, and that is granted so long a term, when compared to its latter duration, is an inhabitant of the water, and bears a very strong resemblance to fishes, in many particulars; having gills by which it breathes at the bottom, and also the tapering form of aquatic animals. These insects have six scaly legs, fixed on their corselet. Their head is triangular: the eyes are placed forward, and may be distinguished by their largeness and colour. The mouth is furnished with teeth; and the body consists of six rings; that next the corselet being largest, but growing less and less to the end: the last ring is the shortest, from which the three threads proceed, which are as long as the whole body. Thus we see that the reptile bears a very strong resemblance to the fly; and only requires wings to be very near its perfection.

As there are several kinds of this animal, their aurelias are consequently of different colours; some yellow, some brown, and some cream-coloured. Some of these also bore themselves cells at the bottom of the water, from which they never stir out, but feed upon the mud composing the walls of their habitation, in contented captivity; others, on the contrary, range about, go from the bottom to the surface, swim between two waters, quit that element entirely to feed upon plants by the river side, and then return to their favourite element for safety and protection.

The reptile, however, though it lives two or three years, offers but little, in its long duration, to excite curiosity: it is hid at the bottom of the water, and feeds almost wholly within its narrow habitation. The most striking facts command our attention during the short interval of its fly state; into which it crowds the most various transactions of its little life. It then may be said to be in a hurry to live, as it has but so small a time to exist. The peculiar sign whereby to know that these reptiles will change into flies in a short time, consists in a protuberance of the wings on the back. About that time the smooth and depressed form of the upper part of the body is changed into a more swollen and rounder shape; so that the wings are, in some degree, visible through the external sheath that covers them. As they are not natives of England, he who would see them in their greatest abundance must walk, about sun-set, along the banks of the Rhine, or the Seine near Paris; where, for about three days, in the midst of summer, he will be astonished at their numbers and assiduity. The thickest descent of the flakes of snow in winter seems not to equal their number: the whole air seems alive with the new-born race; and the earth itself is all over covered with their remains. The aurelias, or reptile insects, that are, as yet, beneath the surface of the water, wait only for the approach of evening to begin their transformation. The most industrious shake off their old garments about eight o'clock; and those who are the most tardy, are transformed before nine.

We have already seen that the operation of change in other insects is laborious and painful; but with these nothing seems shorter, or performed with greater ease. The aurelias are scarcely lifted above the surface of the water, than their old sheathing-skin bursts; and through the cavity which is thus formed, a fly issues, whose wings, at the same instant, are unfolded, and, at the same time, lift it into the air. Millions and millions of aurelias rise in this manner to the surface; and at once become flies, and fill every quarter with their flutterings. But all these sports are shortly to have an end; for, as the little strangers live but an hour or two, the whole swarm soon falls to the ground, and covers the earth, like a deep snow, for several hundred yards, on every side of the river. Their numbers are then incredible, and every object they touch becomes fatal to them; for they instantly die if they hit even against each other.

At this time the males and females are very differently employed. The males, quite in-

active, and apparently without desires, seem only born to die: no way like the males of other insects, they neither follow the opposite sex, nor bear any enmity to each other: after fluttering for an hour or two, they drop upon land, without seeming to receive wings for scarce any other purpose but to satisfy an idle curiosity. It is otherwise with the females; they are scarce risen from the surface of the water, and have dried their wings, but they hasten to drop their eggs back again. If they happen also to flutter upon land, they deposit their burden in the place where they drop. But then it may be demanded, where, and in what manner, are these eggs fecundated, as no copulation whatever appears between the sexes in their transitory visits in air? Swammerdam is of opinion, that they are impregnated in the manner of fish-spawn, by the male, after being ejected by the female; but beside that this doctrine is exploded even from the history of fishes, it is certain that the males have not time for this operation, as the eggs drop to the bottom the instant they are laid on the water. Reaumur is of opinion that they copulate; but that the act bears a proportion in shortness to the small duration of their lives; and, consequently, must be so soon performed as to be scarcely visible. This, however, is at best forcing a theory; and it is probable, that as there are many insects known to breed without any impregnation from the male, as we have already seen in muscles and oysters, and shall hereafter see in the gnat, and a species of the beetle, so the ephemera may be of this number. Be this as it may, the females are in such haste to deposit their eggs, that multitudes of them fall to the ground; but the greatest part are laid in the water. As they flutter upon the surface, two clusters are seen issuing from the extremity of their body, each containing about three hundred and fifty eggs, which make seven hundred in all. Thus, of all insects, this appears to be the most prolific; and it would seem that there was a necessity for such a supply, as, in its reptile state, it is the favourite food of every kind of fresh-water fish. It is in vain that these little animals form galleries at the bottom of the river, from whence they seldom remove; many kinds of fish break in upon their retreats, and thin their numbers. For this reason fishermen are careful to provide themselves with these insects, as the most grateful bait; and thus turn the fish's rapacity to its own destruction.

But though the usual date of those flies is two or three hours at farthest, there are some kinds that live several days; and one kind in particular, after quitting the water, has another case or skin to get rid of. These are often seen in the fields and woods distant from the water; but they are more frequently found in its vicinity. They are often found sticking upon walls and trees; and frequently with the head downwards, without changing place, or having any sensible motion. They are then waiting for the moment when they shall be divested of their last incommodious garment, which sometimes does not happen for two or three days together.[1]

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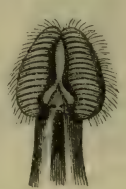
[1] *House-fly.*—Of all insects, perhaps the most widely distributed and abundant in number of individuals, is the house fly, *Musca Domestica*, a species which from its constant occurrence in every situation, will render any precise description of it unnecessary; and yet, many of our readers are, perhaps, unaware that, of the flies which crawl up our windows, there are not only several distinct species, but also that the insect at whose tormenting attacks upon our legs in the showery days of summer, we are so often enraged, does not even belong, notwithstanding its apparent identity, to the same genus. If one of these annoying tormentors (which is the *Stomoxys calcitrans*) be caught and examined, it will be found that the mouth is formed into a horny sharp-pointed weapon, capable of piercing the flesh, whilst the soft blunt apparatus of the mouth of the musca is quite incompetent to such an operation, being fitted only for the sipping of fluids, or the extraction of honied sweets; forming in fact, a long tubular sucker, jointed in the middle so as



B A

Head of the fly, with the mouth extended; A. seen sideways, B. seen from above.

to fold back close to the head (Fig. A. and B.), and armed at the base with a pair of exarticulate feelers and at the extremity with two fleshy lobes, which are employed as instruments of suction. This organ possesses very great muscular power, and we have seen the insect by its assistance alone carry off pieces of sugar much larger than its head. The under surface of the terminal lobes is also transversely ridged, which must necessarily give greater facility to the actions of the organs, by enabling it to adapt itself more readily to rough surfaces (Fig. C.). It is essential, however, that the mouth should be provided

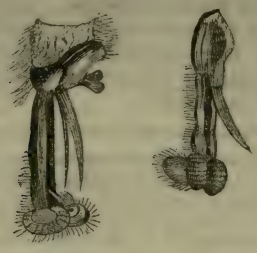


C

Extremity of the sucker of the fly, showing its annulated appearance.

with some instrument for piercing even the soft substances of which the food is composed, and we accordingly find a fine point (the tongue) arising near the elbowed part of the proboscis, which is for safety lodged in a stronger point (the labrum), both when at rest fitting into the canal of the proboscis, as represented in our figure B.

In figure D, we have exhibited the mouth in another position, showing the sharpened upper lip raised from



E D

the fleshy proboscis, and in figure E the mouth of the blue-bottle fly is represented, having the tongue disengaged from the superior stronger labrum.

Another interesting peculiarity observable in the domestic fly, arises from the structure of its feet, enabling it to walk with the greatest facility, not only upon upright surfaces, but also upon the ceilings of rooms, back downwards, without its position being disturbed in consequence of being contrary to gravity. Much diversity of opinion has taken place amongst naturalists upon this curious subject, and even in the latest works we find the matter still forming a "questio vexata." Dr Derham, in his "Physico-Theology," speaking of the means



Leg of the fly highly magnified, with the terminal joint still more increased, seen in different positions, to show the suckers.

whereby insects maintain their position upon smooth substances, states, that "divers flies and other insects, besides their sharp-hooked nails, have also skinny palms to their feet, to enable them to stick on glass and other smooth bodies by means of the pressure of the atmosphere, after the manner as I have seen boys carry heavy stones with only a wet piece of leather clapped on the top of the stone." Gilbert White, of Selborne, adopted Derham's opinion, adding, that although the flies are easily enabled, from their lightness and alertness, to overcome the weight of air in warm weather, yet that in the decline of the year this resistance becomes too mighty for their diminished strength, and we see flies labouring along and lugging their feet in windows as if they stuck fast to the glass, and it is with the utmost difficulty that they can draw one foot from another, and disengage their hollow caps from the slippery surface.

This opinion, which has been entertained by the majority of Entomologists of the present day, has acquired additional weight by the elaborate investigations of Sir Everard Home, undertaken at the suggestion of Sir Joseph Banks, with the assistance of that unrivalled microscopic artist, M. Bauer, and published in the Philosophical Transactions for 1816. The suckers, of which several kinds of flies possess three to each foot, are attached, as will be seen from our figures, beneath the base of the claws, and are of an oval shape and membranous texture, being convex above, having the sides minutely serrated, and the under concave surface covered with down or hairs. In order to cause the alleged vacuum, these suckers are extended, but, when the fly wishes to raise its legs, they are brought together and folded up as it were between the hooks. Messrs. Kirby and Spence have likewise adopted this opinion, considering it as "proved most satisfactorily." Other authors of no mean repute have, however, entertained a different opinion, and have entirely rejected the idea of a vacuum being produced; thus Dr Hooke describes the suckers as palms or soles, beset underneath with small bristles or tenters like the cone teeth of a card for working wool, which he conceived gives them a strong hold upon objects having irregular or yielding surfaces; and he imagined that there is upon glass a kind of smcky substance, penetrable by the points of their bristles. The same opinion is also given by Shaw in his "Nature Displayed," and, more recently, Mr Blackwall has considered that the motions of the fly are to be accounted for upon mechanical principles alone; thus upon inspecting the structure of the parts of the suckers (regarding which great want of accordance exists in the descriptions of authors), "it was immediately perceived that the function ascribed to them by Dr Derham and Sir E. Home is quite incompatible with their organisation. Minute hairs very closely set and directed downwards so completely cover the inferior surface of the expanded membranes, improperly denominated suckers, with which the terminal joint of the foot of flies is provided, that it cannot possibly be brought into contact with the object on which those insects move, by any muscular force they are capable of exerting; the production of a vacuum between each membrane and the plane of position is therefore clearly impracticable, unless the numerous hairs on the underside of these organs individually perform the office of suckers; and there does not appear to be any thing in their mechanism, which in the slightest degree countenances such a hypothesis. When highly magnified, their extremities, it is true, are seen to be somewhat enlarged, but when they are viewed in action or in repose, they never assume a figure at all adapted to the formation of a vacuum."—Moreover, on enclosing a house-fly in the receiver of an air-pump, "it was demonstrated to the entire satisfaction of several intelligent gentlemen present, that the house-fly, while it retains its vital powers unimpaired, cannot only traverse the upright sides, but even the interior of the dome of an *exhausted* receiver, and that the cause of its relaxing its hold, and ultimately falling from the station it occupied, was a diminution of muscular force, attributable to impeded respiration." Hence Mr Blackwall is induced to believe, in the memoir above referred to, that insects are enabled to take hold of any roughness, or irregularity of surface, by means of the fine hairs composing the brushes, the most carefully polished

glass not being found free from flaws and imperfections, when viewed in a favourable light with a powerful lens.

A still different opinion has been maintained by other authors upon this subject; who, setting aside all idea of a vacuum, have conjectured that the suckers, as they have been termed, contain a glutinous secretion, capable of adhering to well-cleaned glass; thus the Abbé de la Pluche states, that when the fly marches over any polished body, on which neither her claws nor her points can fasten, she sometimes compresses her sponge and causes it to evacuate a fluid, which fixes her in such a manner as prevents her falling, without diminishing the facility of her progress; "but it is much more probable," he adds, "that the sponges correspond with the fleshy balls which accompany the claws of dogs and cats, and that they enable the fly to proceed with a softer pace, and contribute to the preservation of its claws, whose pointed extremities would soon be impaired without this prevention." Notwithstanding the ridicule which has been thrown upon this opinion in a recent entomological work, it appears, from still more recent investigations, to be the best founded of any hitherto advanced. Thus, an anonymous writer has published an account of various experiments and examinations upon this subject, which appear satisfactorily to prove, that it is not by the application of extremely small points to invisible irregularities on the surface of glass, that the pulvilli or suckers are attached, but by simple adhesion of the enlarged ends of the hairs assisted by a fluid that is probably secreted there, and the author is therefore reduced to refer the effect to molecular attraction only. It is also stated, that when the foot of the fly is detached, a distinct fluid trace will often be left by each individual hair, the spotty pattern thus left on the glass appearing to be of an oily character, for if breathed on, it remains after the moisture is evaporated. The contrary opinion, although contained in a review of Mr Blackwall's Memoir above noticed, was evidently written in ignorance of the subsequent observations of that author contained in the appendix of the volume in which it appeared, and in which several facts are stated, which appear "quite inexplicable, except on the supposition that an adhesive secretion is emitted by the instruments employed in climbing;" and it is subsequently affirmed, that careful and repeated examinations made with lenses of moderately high magnifying powers, in a strong light and at a favourable angle, speedily convinced Mr Blackwall that his conjecture was well founded, as he never failed to discover "unequivocal evidence of its truth."

We have had a two-fold object in thus setting before the reader, at considerable length, the various opinions promulgated upon the subject,—the first being occasioned by the interest attached to so peculiar a phenomenon; and the second resulting from a desire to show that, even in the commonest insects, there are most ample materials of no ordinary or uninteresting kind for the full exercise of the mind of the ingenious observer of nature. It will seem extraordinary, but it is nevertheless true, that there is scarcely any domestic insect of whose economy we are more ignorant than that of the *Musca domestica*.—*History of Insects*, London 1835.

HISTORY OF INSECTS, &c.

BOOK III.

INSECTS OF THE THIRD ORDER.

CHAP. I.

OF CATERPILLARS IN GENERAL.

If we take a cursory view of insects in general, caterpillars alone, and the butterflies and moths they give birth to, will make a third part of the number. Wherever we move, wherever we turn, these insects, in one shape or another, present themselves to our view. Some, in every state, offer the most entertaining spectacle; others are beautiful only in their winged form. Many persons, of which number I am one, have an invincible aversion to caterpillars and worms of every species: there is something disagreeable in their slow crawling motion, for which the variety of their colouring can never compensate. But others feel no repugnance at observing, and even handling, them with the most attentive application.

There is nothing in the butterfly-state so beautiful or splendid as these insects. They serve, not less than the birds themselves, to banish solitude from our walks, and to fill up our idle intervals with the most pleasing speculations. The butterfly makes one of the principal ornaments of oriental poetry; but in those countries, the insect is larger and more beautiful than with us.

The beauties of the fly may, therefore, very well excite our curiosity to examine the reptile. But we are still more strongly attached to this tribe from the usefulness of one of the number. The silk-worm is, perhaps, the most serviceable of all other animals; since, from its labours, and the manufacture attending it, near a third part of the world are clothed, adorned, and supported.

Caterpillars may be easily distinguished from worms or maggots, by the number of their feet; and by their producing butterflies or moths.[1] When the sun calls up vegetation, and vivifies the various eggs of insects, the caterpillars are the first that are seen upon almost every vegetable and tree, eating its leaves, and preparing for a state of greater perfection. They have feet both before and behind; which not only enable them to move forward by a sort of steps made by their fore and hinder parts, but also to climb up vegetables, and to stretch themselves out from the boughs and

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[1] There is one tribe of caterpillar called *Surveyors*, or *Geometers*, which walk by first fixing the fore-feet, and then doubling the body into a vertical arch; this action brings up the hind part of the caterpillar, which is furnished with prolegs, close to the head. The hind extremity, being then fixed by means of the prolegs situated at that part, the body is again extended into a straight line; and this process being repeated, the caterpillar advances by a succession of paces, as if it were measuring the distance, by converting its body into a pair of compasses. At the same time that they employ this process, they further provide for their security, by spinning a thread, which they fasten to different points of the ground, as they go along.

Many other species of caterpillar practise the same art of spinning fine silken threads, which especially assist them in their progression over smooth surfaces, and also in descending from a height through the air. The caterpillar of the cabbage-butterfly, is thus enabled to climb up and down a pane of glass, for which purpose it fixes the threads that it spins in a zigzag line, forming so many steps of a rope-ladder. The material of which these threads are made, is a glutinous secretion, which, on being deposited on glass, adheres firmly to it, and very soon acquires consistence and hardness by the action of the air.

Other caterpillars, which feed on trees, and have often occasion to descend from one branch to another, send out a rope made with the same material, which they can prolong indefinitely; and thus either suspend themselves at pleasure in the air, or let themselves down to the ground. They continue, while walking, to spin a thread as they advance, so that they can always easily retrace their steps by gathering up the clue they have left, and re-ascend to the height from which they had allowed themselves to drop.—*Dr Roget's Bridgewater Treatise.*

stalks to reach their food at a distance. All of this class have from eight feet, at the least, to sixteen; and this may serve to distinguish them from the worm-tribe, that never have so many. The animal into which they are converted is always a butterfly or moth; and these are always distinguished from other flies, by having their wings covered over with a painted dust, which gives them such various beauty. The wings of flies are transparent, as we see in the common flesh-fly; while those of beetles are hard, like horn: from such, the wing of a butterfly may be easily distinguished; and words would obscure their differences.

From hence it appears, that caterpillars, whether in the reptile state, or advanced to their last state of perfection into butterflies, may easily be distinguished from all other insects; being animals peculiarly formed, and also of a peculiar nature. The transmutations they undergo are also more numerous than those of any insect hitherto mentioned; and, in consequence, they have been placed in the third order of changes by Swammerdam, who has thrown such lights upon this part of natural history. In the second order of changes, mentioned before, we saw the grasshopper and the earwig, when excluded from the egg, assume a form very like that which they were after to preserve; and seemed arrived at a state of perfection, in all respects, except in not having wings; which did not bud forth until they were come to maturity. But the insects of this third order, that we are now about to describe, go through a much greater variety of transformations; for when they are excluded from the egg, they assume the form of a small caterpillar, which feeds and grows larger every day, often changing its skin, but still preserving its form. When the animal has come to a certain magnitude in this state it discontinues eating, makes itself a covering or husk, in which it remains wrapped up, seemingly without life or motion; and after having, for some time, continued in this state, it once more bursts its confinement, and comes forth a beautiful butterfly. Thus we see this animal put on no less than three different appearances from the time it is first excluded from the egg. It appears a crawling caterpillar; then an insensible aurelia, as it is called, without life or motion; and, lastly, a butterfly, variously painted, according to its different kind. Having thus distinguished this class of insects from all others, we will first survey their history in general; and then enter particularly into the manners and nature of a few of them, which most deserve our curiosity and attention.

CHAP. II.

OF THE TRANSFORMATION OF THE CATERPILLAR INTO ITS CORRESPONDING BUTTERFLY OR MOTH.

When winter has disrobed the trees of their leaves, nature then seems to have lost her insects. There are thousands of different kinds, with and without wings, which, though swarming at other seasons, then entirely disappear. Our fields are re-peopled, when the leaves begin to bud, by the genial influence of spring; and caterpillars, of various sorts, are seen feeding upon the promise of the year, even before the leaves are completely unfolded. Those caterpillars, which we then see, may serve to give us a view of the general means, which nature employs to preserve such a number of insects during that season, when they can no longer find subsistence. It is known, by united experience, that all these animals are hatched from the eggs of butterflies; and those who observe them more closely, will find the fly very careful in depositing its eggs, in those places, where they are likely to be hatched, with the greatest safety and success. During winter, therefore, the greatest number of caterpillars are in an egg-state; and in this lifeless situation brave all the rigours and the humidity of the climate; and though often exposed to all its changes, still preserve the latent principles of life, which is more fully exerted at the approach of spring. That same power that pushes forth the budding leaf and the opening flower, impels the insect into animation; and nature at once seems to furnish the guest and the banquet. When the insect has found force to break its shell, it always finds its favourite aliment provided in abundance before it.

But all caterpillars are not sent off from the egg in the beginning of spring; for many of them have subsisted during the winter in their aurelia state; in which as, we have briefly observed above, the animal is seemingly deprived of life and motion. In this state of insensibility, many of these insects continue during the rigours of winter; some inclosed in a kind of shell, which they have spun for themselves at the end of autumn; some concealed under the bark of trees; others in the chinks of old walls; and many buried under ground. From all these, a variety of butterflies are seen to issue in the beginning of spring; and adorn the earliest part of the year with their painted flutterings.

Some caterpillars do not make any change whatsoever at the approach of winter; but continue to live in their reptile state through all the severity of the season. They choose

themselves some retreat, where they may remain undisturbed for months together; and there they continue motionless, and as insensible as if they were actually dead. Their constitution is such, that food at that time would be useless; and the cold prevents their making those dissipations which require restoration. In general, caterpillars of this kind are found in great numbers together, inclosed in one common web, that covers the mall, and serves to protect them from the injuries of the air.

Lastly, there are some of the caterpillar kind, whose butterflies live all the winter; and who, having fluttered about for some part of the latter end of autumn, seek for some retreat during the winter, in order to answer the ends of propagation at the approach of spring. These are often found lifeless and motionless in the hollows of trees or the clefts of timber; but by being approached to the fire, they recover life and activity, and seem to anticipate the desires of the spring.

In general, however, whether the animal has subsisted in an egg state, during the winter; or whether as a butterfly, bred from an aurelia, in the beginning of spring; or a butterfly that has subsisted during the winter, and lays eggs as soon as the leaves of plants are shot forward; the whole swarm of caterpillars are in motion to share the banquet that nature has provided. There is scarcely a plant that has not its own peculiar insects; and some are known to support several of different kinds. Of these, many are hatched from the egg, at the foot of the tree, and climb up to its leaves for subsistence; the eggs of others have been glued by the parent butterfly to the leaves; and they are no sooner excluded from the shell, but they find themselves in the midst of plenty.

When the caterpillar first bursts from the egg, it is small and feeble; its appetites are in proportion to its size, and it seems to make no great consumption; but as it increases in magnitude, it improves in its appetites; so that, in its adult caterpillar state, it is the most ravenous of all animals whatsoever. A single caterpillar will eat double its own weight of leaves in a day, and yet seems no way disordered by the meal. What would mankind do, if their oxen or their horses were so voracious?

These voracious habits, with its slow crawling motion, but still more a stinging like that of nettles, which follows upon handling the greatest number of them, make these insects not the most agreeable objects of human curiosity. However, there are many philosophers who have spent years in their contemplation; and who have not only attended to their habits and labours, but minutely examined their structure and internal conformation.

The body of the caterpillar, when anatomically considered, is found composed of rings, whose circumference is pretty near circular or oval. They are generally twelve in number, and are all membranaceous; by which caterpillars may be distinguished from many other insects, that nearly resemble them in form. The head of the caterpillar is connected to the first ring by the neck; that is generally so short and contracted, that it is scarce visible. All the covering of the head in caterpillars seems to consist of a shell; and they have neither upper nor under jaw, for they are both placed rather vertically, and each jaw armed with a large thick tooth, which is singly equal to numbers. With these the animals devour their food in such amazing quantities; and with these, some of the kind defend themselves against their enemies. Though the mouth be kept shut, the teeth are always uncovered; and while the insect is in health they are seldom without employment. Whatever the caterpillar devours, these teeth serve to chop it into small pieces, and render the parts of the leaf fit for swallowing. Many kinds, while they are yet young, eat only the succulent part of the leaf, and leave all the fibres untouched; others, however, attack the whole leaf, and eat it clean away. One may be amused, for a little time, in observing the avidity with which they are seen to feed; some are seen eating the whole day; others have their hours of repast; some choose the night, and others the day. When the caterpillar attacks a leaf, it places its body in such a manner that the edge of the leaf shall fall between its feet, which keeps it steady while the teeth are employed in cutting it: these fall upon the leaf somewhat in the manner of a pair of gardener's shears; and every morsel is swallowed as soon as cut. Some caterpillars feed upon leaves so very narrow, that they are not broader than their mouths; in this case the animal is seen to devour it from the point, as we would eat a radish.

As there are various kinds of caterpillars, the number of their feet are various; some having eight, and some sixteen. Of these feet the six foremost are covered with a sort of shining gristle; and are therefore called the shelly legs. The hindmost feet, whatever be their number, are soft and flexible, and are called membranaceous. Caterpillars also, with regard to their external figure, are either smooth or hairy. The skin of the first kind is soft to the touch, or hard like shagreen; the skin of the latter is hairy, and as it were thorny; and generally, if handled, stings like nettles. Some of them even cause this stinging pain if but approached too nearly.

Caterpillars, in general, have six small black spots placed on the circumference of the

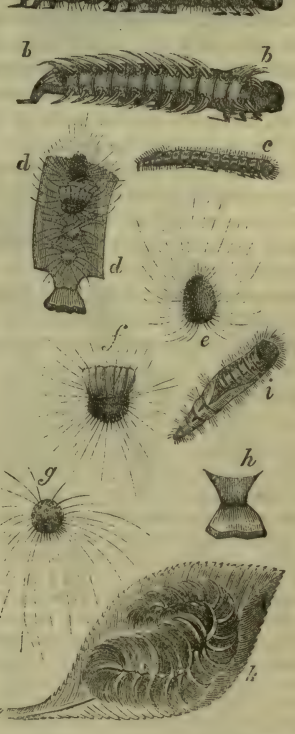
fore ring, and a little to the side of the head. Three of these are larger than the rest, and are convex and transparent: these Reaumur takes to be the eyes of the caterpillar; however most of these reptiles have very little occasion for sight, and seem only to be directed by their feeling.

But the parts of the caterpillar's body which most justly demand our attention, are the stigmata, as they are called; or those holes on the sides of its body, through which the animal is supposed to breathe. All along this insect's body, on each side, these holes are easily discoverable. They are eighteen in number, nine on a side, rather nearer the belly than the back; a hole for every ring, of which the animal's body is composed, except the second, the third, and the last. These oval openings may be considered as so many mouths, through which the insect breathes; but with this difference, that as we have but one pair of lungs, the caterpillar has no less than eighteen. It requires no great anatomical dexterity to discover these lungs in the larger kind of caterpillars: they appear, at first view, to be hollow cartilaginous tubes, and of the colour of mother-of-pearl. These tubes are often seen to unite with each other; some are perceived to open into the intestines; and some go to different parts of the surface of the body. That these vessels serve to convey the air, appears evidently, from the famous experiment of Malpighi; who, by stopping up the mouths of the stigmata with oil, quickly suffocated the animal, which was seen to die convulsed the instant after. In order to ascertain his theory, he rubbed oil upon other parts of the insect's body, leaving the stigmata free; and this seemed to have no effect upon the animal's health, but it continued to move and eat as usual: he rubbed oil on the stigmata of one side, and the animal underwent a partial convulsion, but recovered soon after. However, it ought to be observed, that air is not so necessary to these as to the nobler ranks of animals, since caterpillars will live in an exhausted receiver for several days together; and though they seem dead at the bottom, yet when taken out, recover, and resume their former vivacity.

If the caterpillar be cut upon longitudinally along the back, its intestines will be perceived running directly in a straight line from the mouth to the anus. They resemble a number of small bags opening into each other; and strengthened on both sides by a fleshy cord by which they are united. These insects are, upon many occasions, seen to cast forth the internal coat of their intestines with their food, in the changes which they so frequently undergo. —But the intestines take up but a small part of the animal's body, if compared to the fatty substance in which they are involved. This substance changes its colour when the insect's metamorphosis begins to approach; and from white it is usually seen to become yellow. If to these parts we add the caterpillar's implements for spinning, (for all caterpillars spin at one time or another,) we shall have a rude sketch of this animal's conformation: however, we shall reserve the description of those parts till we come to the history of the silk-worm, where the manner in which these insects spin their webs, will most properly find a place.

The life of a caterpillar seems one continued succession of changes, and it is seen to throw off one skin only to assume another; which also is divested in its turn: and thus for eight or ten times successively.[1] We must not, however, confound this changing of the skin with the great metamorphosis which

[1] One of the most singular circumstances respecting the moult of caterpillars, is the manner in which the hairs are deposited in the new skin before moulting. These are not, like the feet and other organs, sheathed



Moulting of caterpillars. *a a*, caterpillar magnified, *b b*, the same when it has just cast its skin, the hairs still moist; *c*, the same, natural size; *d e f g*, tufts of its hairs magnified; *h*, leg and foot magnified; *i*, the caterpillar wedging through the old skin; *k*, hairy caterpillar of the sycamore.

in the hairs of the old skin, but smoothly folded down in separate tufts; and if the old skin be removed a short

it is afterwards to undergo. The throwing one skin, and assuming another, seems, in comparison, but a slight operation among these animals: this is but the work of a day; the other is the great adventure of their lives. Indeed, this faculty of changing the skin, is not peculiar to caterpillars only, but is common to all the insect kind; and even to some animals that claim a higher rank in nature. We have already seen the lobster and the crab outgrowing their first shells, and then bursting from their confinement, in order to assume a covering more roomy and convenient. It is probable that the louse, the flea, and the spider, change their covering from the same necessity; and growing too large for the crust in which they have been for some time enclosed, burst it for another. This period is probably that of their growth; for as soon as their new skin is hardened round them, the animal's growth is necessarily circumscribed, while it remains within it. With respect to caterpillars, many of them change their skins five or six times in a season; and this covering, when cast off, often seems so complete, that many might mistake the empty skin for the real insect. Among the hairy caterpillars, for instance, the cast skin is covered with hair; the feet, as well gristly as membranous, remain fixed to it; even the parts which nothing but a microscope can discover, are visible in it; in short, all the parts of the head; not only the skull, but the teeth.

In proportion as the time approaches in which the caterpillar is to cast its old skin, its colours become more feeble, the skin seems to wither and grow dry, and in some measure resembles a leaf, when it is no longer supplied with moisture from the stock. At that time, the insect begins to find itself under a necessity of changing; and it is not effected without violent labour, and perhaps pain. A day or two before the critical hour approaches, the insect ceases to eat, loses its usual activity, and seems to rest immovable. It seeks some place to remain in security; and no longer timorous, seems regardless even of the touch. It is now and then seen to bend itself and elevate its back; again it stretches to its utmost extent; it sometimes lifts up the head, and then lets it fall again; it sometimes waves it three or four times from side to side, and then remains in quiet. At length, some of the rings of its body, particularly the first and second, are seen to swell considerably, the old skin distends and bursts, till by repeated swellings and contractions in every ring, the animal disengages itself, and creeps from its inconvenient covering.

How laborious soever this operation may be, it is performed in the space of a minute; and the animal, having thrown off its old skin, seems to enjoy new vigour, as well as acquired colouring and beauty. Sometimes it happens that it takes a new appearance, and colours very different from the old. Those that are hairy still preserve their covering; although their ancient skin seems not to have lost a single hair: every hair appears to have been drawn like a sword from the scabbard. However, the fact is, that a new crop of hair grows between the old skin and the new, and probably helps to throw off the external covering.

The caterpillar having in this manner continued for several days feeding, and at intervals casting its skin, begins at last to prepare for its change into an aurelia. It is most probable that, from the beginning, all the parts of the butterfly lay hid in this insect, in its reptile state; but it required time to bring them to perfection; and a large quantity of food, to enable the animal to undergo all the changes requisite for throwing off these skins, which seemed to clog the butterfly form. However, when the caterpillar has fed sufficiently, and the parts of the future butterfly have formed themselves beneath its skin, it is then time for it to make its first great and principal change into an aurelia, or a chrysalis, as some have chosen to call it; during which, as was observed, it seems to remain for several days, or even months, without life or motion.

Preparatory to this important change, the caterpillar most usually quits the plant, or the tree on which it fed: or at least attaches itself to the stalk or the stem, more gladly than the leaves. It forsakes its food, and prepares, by fasting, to undergo its transmutation. In this period, all the food it has taken is thoroughly digested; and it often voids even the internal membrane which lined its intestines.

Some of this tribe, at this period also, are seen entirely to change colour; and the vivacity of the tints, in all, seems faded.

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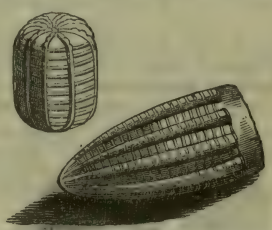
time before it would be naturally cast, these tufts may be seen in a moist state, very similar to small wetted camel's hair pencils lying close to the inner skin,—those on the fore part of the body laid towards the head, and from the fourth ring backwards in a contrary direction. Swammerdam, Reaumur, and other naturalists, repeatedly tried the experiment of cutting off the hair from caterpillars about to moult, without in the least affecting the hairs on the new skin; but when a foot or any other member is accidently mutilated, it is also wanting in the moulted caterpillar. It is a still more singular circumstance, ascertained by Swammerdam, De Geer, Lyonnet, and Bonnet, that caterpillars and grubs not only cast their external skins, but also that which lines their breathing-tubes and intestines. "Some days," says Bonnet, "before the change, the caterpillar voids, along with its excrements, the membrane which invests the interior of its stomach and intestines. I have also remarked, that during the moult, packets of the tracheal vessels may be seen attached to the cast skin, and thrown off along with it."—*Insect Transformations.*

Those of them which are capable of spinning themselves a web, set about this operation; those which have already spun, await the change in the best manner they are able. The web or cone, with which some cover themselves, hides the aurelia contained within from the view; but in others, where it is more transparent, the caterpillar, when it has done spinning, strikes into it the claws of the two feet under the tail, and afterwards forces in the tail itself, by contracting those claws, and violently striking the feet one against the other. If, however, they be taken from their web at this time, they appear in a state of great languor; and, incapable of walking, remain on that spot where they are placed. In this condition they remain one or two days, preparing to change into an aurelia; somewhat in the manner they made preparations for changing their skin. They then appear with their bodies bent into a bow, which they now and then are seen to straighten: they make no use of their legs; but if they attempt to change place, do it by the contortions of their body. In proportion as their change into an aurelia approaches, their body becomes more and more bent; while their extensions and convulsive contractions become more frequent. The hinder end of the body is the part which the animal first disengages from its caterpillar skin; that part of the skin remains empty, while the body is drawn up contractedly towards the head. In the same manner they disengage themselves from the two succeeding rings; so that the animal is then lodged entirely in the fore part of its caterpillar covering: that half which is abandoned, remains flaccid and empty; while the fore part on the contrary, is swollen and distended. The animal, having thus quitted the hinder part of its skin, to drive itself up into the forepart, still continues to heave and work as before; so that the skull is soon seen to burst into three pieces, and a longitudinal opening is made in the three first rings of the body, through which the insect thrusts forth its naked body with strong efforts. Thus at last it entirely gets free from its caterpillar skin, and for ever forsakes its most odious reptile form.

The caterpillar, thus stripped of its skin for the last time, is now become an aurelia: in which the parts of the future butterfly are all visible; but in so soft a state, that the smallest touch can discompose them. The animal is now become helpless and motionless; but only waits for the assistance of the air to dry up the moisture on its surface, and supply it with a crust capable of resisting external injuries. Immediately after being stripped of its caterpillar skin, it is of a green colour, especially in those parts which are distended by an extraordinary afflux of animal moisture; but in ten or twelve hours after being thus exposed, its parts harden, the air forms its external covering in a firm crust, and in about four and twenty hours the aurelia may be handled, without endangering the little animal that is thus left in so defenceless a situation. Such is the history of the little pod or cone that is found so common by every path way, sticking to nettles, and sometimes shining like polished gold. From the beautiful and resplendent colour with which it is thus sometimes adorned, some authors have called it a Chrysalis, implying a creature made of gold.[1]

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[1] *Transformations of the Butterfly.* The metamorphoses which a butterfly undergoes will be found depicted in the following Cuts. The *eggs of a butterfly and moth* are first given, as they appear under magnifying glasses.



The eggs of insects vary much more in form than those of birds, and the reason of this appears to be that the in



sects themselves differ from each other in their general form more than birds. In the annexed cut, fig. 1. represents the larva just issued from the egg. Fig 2. the

Such are the efforts by which these little animals prepare for a state of perfection; but their care is still greater to provide themselves a secure retreat, during this season of their imbecility. It would seem like erecting themselves a monument, where they were to rest secure, until Nature had called them into a new and more improved existence. For this purpose, some spin themselves a cone or web, in which they lie secure till they have arrived at maturity: others, that cannot spin so copious a covering, suspend themselves by the tail, in some retreat where they are not likely to meet disturbances. Some mix sand with their gummy and moist webs, and thus make themselves a secure incrustation; while others, before their change, bury themselves in the ground, and thus avoid the numerous dangers that might attend them. One would imagine that they were conscious of the precise time of their continuance in their aurelia state; since their little sepulchres, with respect to the solidity of the building, are proportioned to such duration. Those that are to lie in that state of existence but a few days, make choice of some tender leaf, which they render still more pliant by diffusing a kind of glue upon it: the leaf thus gradually curls up, and withering as it unfolds, the insect wraps itself within, as in a mantle, till the genial warmth of the sun enables it to struggle for new life, and burst from its confinement.[1] Others,

same in progress to maturity. 3. The same at its full growth. 4. Its appearance when about to change into the pupa state. 5. In the act of changing on the following day. 6. The pupa come forth, the change having been performed in about four minutes. The exuvia of the larva being raised up to the point of suspension, was thrown off, and is represented afterwards at fig. 7. After remaining in the pupa state about twelve days, the perfect insect begins to appear as at fig. 8. 9 represents the butterfly in the act of escape, and 11 *a* the pupa case. The following (11 *b*) is the insect totally extricated, with



the wings folded, collapsed, and humid. 15 is the head of the larva magnified. We have now (12) the insect gradually expanding the wings, during which oper-



ation it voids a sanguineous-looking excrement. And last (fig. 13) the perfect insect (a *papileo Urticæ*) is seen



with the wings expanded for flight. The whole of the process from fig. 8. is performed in about seven minutes.

[1] *Leaf-Rolling Caterpillars.*—The caterpillars which are familiarly termed leaf-rollers, are perfect hermits. Each lives in a cell, which it begins to construct almost immediately after it is hatched; and the little structure is at once a house which protects the caterpillar from its enemies, and a store of food for its subsistence, while it remains shut up in its prison. But the insect only devours the inner folds. The art which these caterpillars exercise, although called into action but once, perhaps, in their lives, is perfect. They accomplish their purpose with a mechanical skill, which is remarkable for its simplicity and unerring success. The art of rolling leaves into a secure and immovable cell may not appear very difficult; nor would it be so if the caterpillars had fingers, or any parts which were equivalent to those delicate and admirable natural instruments with which man accomplishes his most elaborate works. And yet the human fingers could not roll a rocket-case of paper more regularly than the caterpillar rolls his house of leaves. A leaf is not a very easy substance to roll. In some trees it is very brittle. It has also a natural elasticity,—a disposition to spring back if it be bent,—which is caused by the continuity of its threads, or nervures. This elasticity is speedily overcome by the ingenuity with which the caterpillar works; and the leaf is thus retained in its artificial position for many weeks, under every variety of temperature. We will examine, in detail, how these little leaf-rollers accomplish their task.

One of the most common as well as the most simple fabrics constructed by caterpillars, may be discovered during summer on almost every kind of bush and tree. We shall take as examples those which are found on the lilac, and on the oak.

A small but very pretty chocolate-coloured moth, abundant in every garden, but not readily seen from its frequently alighting on the ground which is so nearly of its own colour, deposits its eggs on the leaves of the lilac, and of some other trees, appropriating a leaf to each egg. As soon as the caterpillar is hatched, it begins to secure itself from birds and predatory insects by rolling up the lilac leaf into the form of a gallery, where it may feed in safety. We have repeatedly seen one of them when just escaped from the egg, and only a few lines long, fix several silk threads from one edge of a leaf, to the other, or from the edge to the mid-rib. Then going to the middle of the space, he shortened the threads by bending them with his feet, and consequently pulled the edges of the leaves into a circular form; and he retained them in that position by glueing down each thread as he shortened it. In their younger state, these caterpillars seldom roll more than a small portion of the leaf; but when farther advanced, they unite the two edges toge-

whose time of transformation is also near at hand, fasten their tails to a tree, or to the first worm-hole they meet in a beam, and wait in that defenceless situation. Such caterpillars, on the other hand, as are seen to lie several months in their aurelia state, act with much greater circumspection. Most of them mix their web with sand, and thus make themselves a strong covering: others build in wood, which serves them in the nature of a coffin. Such as have made the leaves of willows their favourite food, break the tender twigs of them first into small pieces, then pound them as it were to powder; and, by means of their glutinous silk, make a kind of paste, in which they wrap themselves up. Many are the forms which these animals assume in this helpless state; and it often happens, that the most deformed butterflies issue from the most beautiful aurelias.

In general, however, the aurelia takes the rude outline of the parts of the animal which is contained within it; but as to the various colours which it is seen to assume, they are rather the effect of accident; for the same species of insect does not at all times assume the same hue, when it becomes an aurelia. In some the beautiful gold colour is at one time found; in others, it is wanting. This brilliant hue, which does not fall short of the best gilding, is formed in the same manner in which we see leather obtain a gold colour, though none of that metal ever enters into the tincture. It is only formed by a beautiful brown varnish, laid upon a white ground; and the white thus gleaming through the transparency of the brown, gives a charming golden yellow. These two colours are found, one over the other, in the aurelia of the little animal we are describing; and the whole appears gilded without any real gilding.

The aurelia thus formed, and left to time to expand into a butterfly, in some measure resembles an animal in an egg, that is to wait for external warmth to hatch it into life and vigour. As the quantity of moisture, that is

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ther in their whole extent, with the exception of a small opening at one end, by which an exit may be made in case of need.



Nest of a Lilac-leaf Roller.

Another species of caterpillar closely allied to this, rolls up the lilac-leaves in a different form, beginning at the end of a leaf, and fixing and pulling its threads till it gets it nearly into the shape of a scroll of parchment. To retain this form more securely, it is not contented, like the former insect, with threads fixed on the inside of the leaf; but has also recourse to a few cables which it weaves on the outside.

Another species of moth allied to the two preceding, is of a pretty green colour, and lays its eggs upon the leaves of the oak. This caterpillar folds them up in a similar manner, but with this difference, that it works on the under surface of the leaf, pulling the edge downwards and backwards, instead of forwards and upwards. This species is very abundant, and may readily be found as soon as the leaves expand. In June, when the perfect insect has appeared, by beating a branch of an oak, a whole shower of these pretty green moths may be shook into the air.

Among the leaf-rolling caterpillars, there is a small dark-brown one, with a black head and six feet, very common in gardens on the currant-bush or the leaves of the rose-tree. (*Lozotænia Rosana*, Stephens.) It is exceedingly destructive to the flower-buds. The eggs are deposited in the summer, and probably also in the autumn or in spring, in little oval or circular patches of a green colour. The grub makes its appearance with the first opening of the leaves, of whose structure in the half-expanded state it takes advantage to construct its summer tent. It is not, like some of the other leaf-rollers, contented with a single leaf, but weaves together as many as there are in the bud where it may chance to have been hatched, binding their discs so firmly with silk, that all the force of the ascending sap, and the increasing growth of the leaves, cannot break through; a farther expansion is of course prevented. The little inhabitant in the mean while banquets securely on the partitions of its tent, eating door-ways from one apartment into another, through which it can escape in case of danger or disturbance.

The leaflets of the rose, it may be remarked, expand in nearly the same manner as a fan, and the operations of this ingenious little insect retain them in the form of a fan nearly shut. Sometimes, however, it is not contented with one bundle of leaflets, but by means of its silken cords unites all which spring from the same bud into a rain proof canopy, under the protection of which it can feast on the flower-bud, and prevent it from ever blowing.

In the instance of the currant leaves, the proceedings of the grub are the same, but it cannot unite the plaits so smoothly as in the case of the rose leaflets, and it requires more labour also, as the nervures being stiff, demand a greater effort to bend them. When all the exertions of the insect prove unavailing in its endeavours to draw the edges of a leaf together, it bends them inwards as far as it can, and weaves a close web of silk over the open space between. This is well exemplified in one of the commonest of our leaf-rolling caterpillars, which may be found as early as February on the leaves of the nettle and the white archangel (*Lamium album*,) It is of a light dirty-green colour, spotted with black, and covered with a few hairs. In its young state it confines itself to the bosom of a small leaf, near the insertion of the leaf-stalk, partly bending the edges inwards, and covering in the interval with a silken curtain. As this sort of covering is not sufficient for concealment when the animal advances in growth, it abandons the base of the leaf for the middle, where it doubles up one side in a very secure and ingenious manner.—*Rennie's Insect Architecture.*

inclosed within the covering of the aurelia, continues to keep its body in the most tender state, so it is requisite that this humidity should be dried away, before the little butterfly can burst its prison. Many have been the experiments to prove that nature may in this respect be assisted by art; and that the life of the insect may be retarded or quickened, without doing it the smallest injury. For this purpose, it is only requisite to continue the insect in its aurelia state, by preventing the evaporation of its humidity; which will consequently add some days, nay weeks, to its life: on the other hand, by evaporating its moisture in a warm situation, the animal assumes its winged state before its usual time, and goes through the offices assigned its existence. To prove this, Mr Reaumur enclosed the aurelia in a glass tube; and found the evaporated water, which exhaled from the body of the insect, collected in drops at the bottom of the tube: he covered the aurelia with varnish; and this making the evaporation more difficult and slow, the butterfly was two months longer than its natural term in coming out of its case: he found, on the other hand, that by laying the animal in a warm room, he hastened the disclosure of the butterfly; and by keeping it in an ice-house, in the same manner he delayed it. Warmth acted, in this case, in a double capacity: invigorating the animal, and evaporating the moisture.

The aurelia, though it bears a different external appearance, nevertheless contains within it all the parts of the butterfly in perfect formation; and lying each in a very orderly manner, though in the smallest compass. These, however, are so fast and tender, that it is impossible to visit without discomposing them. When either by warmth, or increasing vigour, the parts have acquired the necessary force and solidity, the butterfly then seeks to disembarrass itself of those bands which kept it so long in confinement. Some insects continue under the form of an aurelia not above ten days; some twenty; some several months; and even for a year together.

The butterfly, however, does not continue so long under the form of an aurelia, as one would be apt to imagine. In general those caterpillars that provide themselves with cones, continue within them but a few days after the cone is completely finished. Some, however, remain buried in this artificial covering for eight or nine months, without taking the smallest sustenance during the whole time: and though in the caterpillar state no animals were so voracious, when thus transformed they appear a miracle of abstinence. In all, sooner or later, the butterfly bursts from its prison; not only that natural prison which is formed by the skin of the aurelia, but also from that artificial one of silk, or any other substance in which it has enclosed itself.

The efforts which the butterfly makes to get free from its aurelia state, are by no means so violent as those which the insect had in changing from the caterpillar into the aurelia. The quantity of moisture surrounding the butterfly is by no means so great as that attending its former change; and the shell of the aurelia is so dry, that it may be cracked between the fingers.

If the animal be shut up within a cone, the butterfly always gets rid of the natural internal skin of the aurelia, before it eats its way through the external covering which its own industry has formed round it. In order to observe the manner in which it thus gets rid of the aurelia covering, we must cut open the cone, and then we shall have an opportunity of discovering the insect's efforts to emancipate itself from its natural shell. When this operation begins, there seems to be a violent agitation in the humours contained within the little animal's body. Its fluids seem driven by a hasty fermentation, through all the vessels; while it labours violently with its legs, and makes several other violent struggles to get free. As all these motions concur with the growth of the insect's wings and body, it is impossible that the brittle skin which covers it should longer resist: it at length gives way by bursting into four distinct and regular pieces. The skin of the head and legs first separates; then the skin at the back flies open, and dividing into two regular portions, disen gages the back and wings: then there likewise happens another rupture, in that portion which covered the rings of the back of the aurelia. After this, the butterfly, as if fatigued with its struggles, remains very quiet for some time, with its wings pointed downwards, and its legs fixed in the skin which it had just thrown off. At first sight the animal, just set free, and permitted the future use of its wings, seems to want them entirely; they take up such little room, that one would wonder where they were hidden. But soon after they expand so rapidly, that the eye can scarce attend their unfolding. From reaching scarce half the length of the body, they acquire, in a most wonderful manner, their full extent and bigness, so as to be each five times larger than they were before. Nor is it the wings alone that are thus increased; all their spots and paintings before so minute as to be scarce discernible, are proportionably extended; so that what a few minutes before seemed only a number of confused unmeaning points, now become distinct and most beautiful ornaments. Nor are the wings, when they are thus expanded, unfolded in the manner in which earwigs and grasshoppers display theirs, who unfurl them

like a lady's fan: on the contrary, those of butterflies actually grow to their natural size in this very short space. The wing, at the instant it is freed from its late confinement, is considerably thicker than afterwards; so that it spreads in all its dimensions, growing thinner as it becomes broader. If one of the wings be plucked from the animal just set free, it may be spread by the fingers, and it will soon become as broad as the other which has been left behind. As the wings extend themselves so suddenly, they have not yet had time to dry; and accordingly appear like pieces of wet paper, soft and full of wrinkles. In about half an hour they are perfectly dry, their wrinkles entirely disappear, and the little animal assumes all its splendour. The transmutation being thus perfectly finished, the butterfly discharges three or four drops of a blood-coloured liquid, which are the last remains of its superfluous moisture.[1] Those aurelias which are enclosed within a cone, find that exit more difficult, as they have still another prison to break through: this, however, they perform in a short time; for the butterfly, freed from its aurelia skin, butts with its head violently against the walls of its artificial prison; and probably with its eyes, that are rough and like a file, it rubs the internal surface away; till it is at last seen bursting its way into open light; and, in less than a quarter of an hour, the animal acquires its full perfection.

Thus, to use the words of Swammerdam, we see a little insignificant creature distinguished, in its last birth, with qualifications and ornaments, which man, during his stay upon earth, can never even hope to acquire. The butterfly, to enjoy life, needs no other food but the dews of heaven, and the honeyed juices which are distilled from every flower. The pageantry of princes cannot equal the ornaments with which it is invested; nor the rich colouring that embellishes its wings. The skies are the butterfly's proper habitation, and the air is its element: whilst man comes into the world naked, and often roves about without habitation or shelter; exposed on one hand to the heat of the sun, and on the other to the damps and exhalations of the earth; both alike enemies of his happiness and existence. A strong proof that, while this little animal is raised to its greatest height, we are as yet in this world only candidates for perfection!

[1] These red drops, which several of the butterfly tribe discharge immediately upon their transformation, have been recorded by ancient writers as showers of blood, portending some convulsion of nature, or national calamity. In the year 1608, the inhabitants of the town of Aix were in the utmost consternation, in consequence of a discharge of this kind, which fell in the suburbs, and for some miles round. But the philosopher Pieresc soon quieted their alarms, by showing them that the whole of this wonder originated in a flight of harmless butterflies, that had just taken wing from their chrysalis state.—*Note by Goldsmith.*

CHAP. III.

OF BUTTERFLIES AND MOTHS.[2]

It has been already shown, that all butterflies are bred from caterpillars; and we have

[2] *Butterflies*, *Hawk-moths*, and *Moths* belong to the order *Lepidoptera*, so called from the scales on their wings. Their generic names are *Papilio*, *Sphinx*, and *Phalæna*: recent writers have divided them according to the seasons of their flight, into Diurnal, Crepuscular, and Nocturnal. "The term *Butterfly*," says Mr Duncan, in the Naturalist's Library, "is a literal translation of the Saxon word *Buttor-fleoze*, and is supposed to be applied because the insects first become prevalent in the beginning of the season for butter. They are distinguished from the other scaly-winged kinds, by possessing antennæ with a knob or club at the summit, * and holding their wings, when in a state of repose, erect or very slightly inclined. They are the most generally and familiarly known of our insect tribes, and, by their conspicuous appearance, seldom fail to attract the notice even of those whose perceptions are least alive to the beauty of natural objects. The graceful curves of their outline—their gay and fitful flight—the splendour of their colouring and decorations, which present every variety of tint found in the different kingdoms of nature, distributed in markings and delineations of the most beautiful and diversified character, seem to confer on them a kind of superiority over other insects. Some naturalists have accordingly considered them as entitled to stand at the head of the insect class: and if, as Mr Kirby remarks, beauty, and grace, and gaiety, and splendour of colours were the great requisite, and the law enjoined *Detur pulchriori*—they are doubtless deserving of this preference. Their wings are augmented to a size that seems quite disproportioned to that of the body, as if nature had wished to enlarge the surface on which she was to employ her pencil, that it might admit of more varied and profuse decoration. Even the under face of the wings, contrary to what is observed in other flying animals, is usually as much adorned as the surface, and often in an entirely different manner. Each wing, therefore, presents what may be called two different pictures. No kind of ornament found among other insects is omitted in this favoured tribe: and so many new modes of embellishment are employed, that nature seems to have made them the objects of her peculiar care, and designed them, as has been remarked by the learned and pious Ray, for the adornment of the universe, and to form delightful objects for the contemplation of man, bearing conspicuous marks of the hand of a divine Artist.

"The habits of these insects are well fitted to confirm the preference we assign to their beauty. Unlike many others of this class, which delight to riot among substances most offensive to our senses, or which destroy the property and lives of their less powerful companions, butterflies derive their sustenance from the nectareous juices and secretions of fruits and flowers. Instead of grovelling on the 'dungy earth,' they are generally seen either sporting in the air, or resting on the disk of some ex-

* Certain foreign genera, however, such as Morpho and Urania, form an exception to this rule, as they have antennæ either of equal thickness throughout, or tapering slightly to the summit.

exhibited the various circumstances of that surprising change. It has been remarked, that butterflies may be easily distinguished from flies of every other kind, by their wings: for, in others, they are either transparent, like gauze, as we see in the common flesh-fly; or they are hard and crusted, as we see in the wings of the beetle. But in the butterfly, the

panded flower, and all their habits are such as beseem 'pure creatures of the element.' They are seldom noticed but in fine weather, and never in profusion but when the season is in its highest bloom, and their appearance thus becomes associated in our minds with the charms of external nature, and is connected with those images of life and beauty which give rise to many of the genial influences of summer. Several species also contrive to outlive the winter, although their frail forms seem but ill adapted to resist the rigours of that inclement season, and issuing from their retreats in the first warm days of spring, are among the earliest and not least interesting heralds of the 'purple year *.' These circumstances, together with the very striking manner in which they exhibit the phenomena of transformation, have long rendered them general favourites, and caused their history to be investigated with greater attention than has been bestowed on insects of a less conspicuous and attractive kind.

"The diurnal Lepidoptera (or butterflies) are very numerous in species, although but a limited number inhabit this country. Between 2000 and 3000 have been described, and it is probable that no inconsiderable number yet remain undiscovered. About seventy-five different species are recorded as indigenous to Britain. A great proportion of the largest and most highly ornamented kinds are natives of the new world, especially of Brazil; but they abound in all tropical countries, and some of these exotics present the most sumptuous examples of insect beauty. 'I should undertake an endless task,' say Messrs Kirby and Spence, or one or other of these authors 'did I attempt to specify all the modes of marking, clouding, and spotting, that variegate a wing, and all the shades of colour that paint it, among the lepidopterous tribes; I shall therefore confine myself to a few of the principal, especially those that distinguish particular tribes and families. Of whole coloured wings, I know none that dazzle the eye of the beholder so much as the upper surface of those of *Morpho Menelaus* and *Telemachus*. Linné justly observes, that there is scarcely any thing in nature that, for brightness and splendour, can be paralleled with this colour: it is a kind of rich ultramarine, that vies with the deepest and purest azure of the sky; and, what must cause a striking contrast in flight, the prone surface of the wings is as dull and dark as the supine is brilliant, so that one can conceive this animal to appear like a planet in full radiance, and under eclipse, as its wings open and shut in the blaze of a tropical sun. Another butterfly *(Papilio Ulysses)* by its radiating cerulean disk, surrounded on every side by a margin intensely black, gives the idea of light first emerging from primeval obscurity: it was probably this idea of light shining in darkness, that induced Linné to give it the name of the wisest of the Greeks in a dark and barbarous age. I know no insect upon which the sight rests with such untired pleasure as upon the lovely butterfly that bears the name of the unhappy Trojan king *(P. Priamus)*; the contrast of the rich green and black of the velvet of its wings with each other, and with the orange of its abdomen, is beyond expression regal and magnificent.'

"Although our British butterflies can in no way compete with the magnificent examples just referred to, we yet possess many of great beauty, whether as regards the brilliancy of their colour, or the harmonious manner in which these colours are distributed. The bluish-purple reflection that plays on the wings of the Emperor of the woods, has a richness and brilliancy of tint, which is not often surpassed. The prevailing hue among the *Lycænæ*, is fulgid copper colour, of a high degree of resplendency; and the *Polyommati*, which are so abundant in our pastures, are remarkable for exhibiting, in great variety of shade, the most delicate and beautiful tints of blue. What can exceed the fine pencilling and harmonious tinting on the under surface of the wings of *Cynthia Cardui*, *Limenitis Camilla*, and *Vanessa Atalanta*; or the richness of the eye-like spots that decorate the wings of the peacock butterfly, and numerous other species? The warm and beautiful shades of yellow in *Colias* and *Gonepteryx*, render them objects on which the eye rests with continual pleasure; and the silvery spots and streaks on the under side of the *Fritillaries*, form a fine relief, by their brilliant metallic lustre, to the uniform and comparatively duller tints of black and brown which predominate among that tribe.

"The mode of painting employed to produce these rich tints, may not improperly be called a kind of natural mosaic, for the colours invariably reside in the scales, which form a dense covering over the whole surface. These scales are usually of an oval or elongated form, and truncated at the tip, where they are occasionally divided into teeth; but sometimes they are conical, linear, or triangular. They are fixed in the wing by means of a narrow pedicle, and are most commonly disposed in transverse rows, placed close together, and overlapping each other like the tiles of a roof. In some instances, they are placed without any regular order, and in certain cases there appear to be two layers of scales on both sides of the wings. When they are rubbed off, the wing is found to consist of an elastic membrane, thin and transparent, and marked with slightly indented lines, forming a kind of groove for the insertion of the scales. The latter are so minute that they appear to the naked eye like powder or dust, and as they are very closely placed, their numbers on a single insect are astonishingly great. Leeuwenhoek counted upwards of 400,000 on the wings of the silk moth, an insect not above one-fourth of the size of some of our native butterflies. But how much inferior must this number be to that necessary to form a covering to some foreign butterflies, the wings of which expand upwards of half a foot: or certain species of moths, some of which (such as the atlas moth of the east, or the great owl moth of Brazil,) sometimes measure nearly a foot across the wings! A modern mosaic picture may contain 870 tesserulæ, or separate pieces, in one square inch of surface: but the same extent of a butterfly's wing sometimes consists of no fewer than 100,736!

"In common with several other extensive races of insects, butterflies derive their nourishment entirely from liquid substances, and the structure of the mouth is consequently very different from that of the masticating kinds. They are hence classed among the haustellated or suctorial tribes of insects. The most conspicuous and elaborately constructed organ, is the long flexible tube projecting from the mouth, which forms a canal through which the alimentry juices are absorbed. This instrument, which is sometimes of great length, is spirally convoluted when unemployed, but it can be unrolled with great rapidity, and is admirably fitted to explore the tubular corollas and deep-seated nectaries of flowers, for the purpose of extracting their sweet secretions. It is of

* In the sunny clime of Italy, where it may be said that nature never dies, and probably also in other southern countries of Europe, most of the species which with us retire on the approach of winter into the crevices of walls, and other sheltered situations, are seen upon the wing throughout even the colder months—at least we know that it is so with *Van. cardui, Atalanta*, and a few others.

wings are soft, opaque, and painted over with a beautiful dust, that comes off with handling.

The number of these beautiful animals is very great; and though Linnæus has reckoned up above seven hundred and sixty different kinds, the catalogue is still very incomplete. Every collector of butterflies can show undescribed species: and such as are fond of minute discovery can here produce animals that have been examined only by himself. In general, however, those of the warm climates are larger and more beautiful than such as are bred at home; and we can easily admit the beauty of the butterfly, since we are thus freed from the damage of the caterpillar. It has been the amusement of some to collect these animals from different parts of the world; or to breed them from caterpillars at home. These they arrange in systematic order, or dispose so as to make striking and agreeable pictures; and all must grant, that this specious idleness is far preferable to that unhappy state which is produced by a total want of employment.

The wings of butterflies, as was observed, fully distinguish them from flies of every other kind. They are four in number; and though two of them be cut off, the animal can fly with the two others remaining. They are, in their own substance, transparent; but owe their opacity to the beautiful dust with which they are covered; and which has been likened, by some naturalists, to the feathers of birds; by others, to the scales of fishes: as their imaginations were disposed to catch the resemblance. In fact, if we regard the wing of a butterfly with a good microscope, we shall perceive it studded over with a variety of little grains of different dimensions and forms, generally supported upon a footstalk, regularly laid upon the whole surface. Nothing can exceed the beautiful and regular arrangement of these little substances: which thus serve to paint the butterfly's wing like the tiles of a house. Those of one rank are a little covered by those that follow: they are of many figures; on the part of the wing may be seen a succession of oval studs; on another part, a cluster of studs, each in the form of a heart: in one place they resemble a hand open; and in another they are long or triangular; while all are interspersed with taller studs, that grow between the rest, like mushrooms upon a stalk. The wing itself is composed of several thick nerves, which render the construction very strong, though light; and though it be covered over with thousands of these scales or studs, yet its weight is very little increased by the number. The animal is with ease enabled to support itself a long while in air, although its flight be not very graceful. When it designs to fly to a considerable distance, it ascends and descends alternately; going sometimes to the right and sometimes to the left, without any apparent reason. Upon closer examination, however, it will be found that it flies thus irregularly in pursuit of its mate; and as dogs bait and quarter the ground in pursuit of their game, so these insects traverse the air in quest of their mates, whom they discover at more than a mile's distance.

If we prosecute our description of the butterfly, the animal may be divided into three parts; the head, the corselet, and the body.

The body is the hinder part of the butterfly, and is composed of rings, which are generally concealed under long hair, with which that part of the animal is clothed. The corselet is more solid than the rest of the body, because the forewings and the legs are fixed therein. The legs are six in number, although four only are made use of by the animal; the two forelegs being often so much concealed in the long hair of the body, that it is sometimes difficult to discover them. If we examine these parts internally, we shall find the same set of vessels in the butterfly that we observed in the caterpillar; but with this great difference, that as the blood or humours in the caterpillar circulated from the tail to the head, they are found in the butterfly to take a direct contrary course, and to circulate from the head to the tail; so that the caterpillar may be considered as the embryo animal, in which, as we have formerly seen, the circulation is carried on

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a cartilaginous substance, and owes its great flexibility to its being composed of numerous rings or transverse fibres, bearing some resemblance to the annulose structure of earth-worms and some other animals. It is formed of two distinct pieces, which admit of being separated throughout their whole length. Each of these pieces is traversed longitudinally by a cylindrical tube, and being grooved on their inner side, they form when united another canal in the centre, of a somewhat square form, and wider than either of the two lateral ones. The junction of the two parts is so close that the enclosed tube is perfectly air-tight: and this union is effected by means of an infinite number of filets, resembling the laminæ of a feather, which interlace and adhere to each other. Of these three tubes, the central one alone serves for the influx of the alimentary fluids, the two lateral ones being probably employed in transmitting air in aid of respiration, which, however, is mainly carried on by means of stigmata or literal pores. The outer extremity of the proboscis is frequently beset with many membraneous papillæ, resembling leaflets, which have been regarded by some authors as absorbents. From having observed them chiefly in long and slender trunks, Reaumur was led to conceive, that their only use is to render that organ more steady, by affording numerous points of support, and adhering in some degree to the substances into which it is inserted;—an explanation rendered highly probable by the fact, that the long and slender ovipositors of ichneumons, and many other insects, are generally provided with some pointed projections near the tip, evidently intended for this purpose."—*Naturalist's Library. British Butterflies. By James Duncan, Edin.* 1835.

differently from what it is in animals when excluded.

But leaving the other parts of the butterfly, let us turn our attention particularly to the head. The eyes of butterflies have not all the same form; for in some they are large, in others small; in some they are the larger portion of a sphere, in others they are but a small part of it, and just appearing from the head. In all of them, however, the outward coat has a lustre, in which may be discovered the various colours of the rainbow. When examined a little closely, it will be found to have the appearance of a multiplying-glass; having a great number of sides or facets, in the manner of a brilliant cut diamond. In this particular the eye of the butterfly, and of most other insects, entirely correspond; and Leuwenhoek pretends there are about six thousand facets on the cornea of the flea. These animals, therefore, see not only with great clearness, but view every object multiplied in a surprising manner. Puget adapted the cornea of a fly in such a position as to see objects through it by the means of a microscope; and nothing could exceed the strangeness of its representation. A soldier, who was seen through it, appeared like an army of pigmies; for while it multiplied, it also diminished the object; the arch of a bridge exhibited a spectacle more magnificent than human skill could perform; the flame of a candle seemed a beautiful illumination. It still, however, remains a doubt, whether the insect sees objects singly, as with one eye; or whether every facet is itself a complete eye, exhibiting its own object distinct from all the rest.

Butterflies, as well as most other flying insects, have two instruments, like horns, on their heads, which are commonly called feelers. They differ from the horns of greater animals, in being movable at their base; and in having a great number of joints, by which means the insect is enabled to turn them in every direction. Those of butterflies are placed at the top of the head, pretty near the external edge of each eye. What the use of these instruments may be, which are thus formed with so much art, and by a Workman who does nothing without reason, is as yet unknown to man. They may serve to guard the eye; they may be of use to clean it; or they may be the organ of some sense which we are ignorant of: but this is only explaining one difficulty by another. We are not so ignorant of the uses of the trunk, which few insects of the butterfly kind are without. This instrument is placed exactly between the eyes; and when the animal is not employed in seeking its nourishment, it is rolled up like a curl. A butterfly, when it is feeding, flies round some flower and settles upon it. The trunk is then uncurled, and thrust out either wholly or in part; and is employed in searching the flower to its very bottom, let it be ever so deep. This search being repeated seven or eight times, the butterfly then passes to another; and continues to hover over those agreeable to its taste, like a bird over its prey. This trunk consists of two equal hollow tubes, nicely joined to each other, like the pipes of an organ.

Such is the figure and conformation of these beautiful insects, that cheer our walks, and give us the earliest intimations of summer. But it is not by day alone that they are seen fluttering wantonly from flower to flower, as the greatest number of them fly by night, and expand the most beautiful colouring at those hours when there is no spectator. This tribe of insects has, therefore, been divided into Diurnal and Nocturnal Flies; or, more properly speaking, into Butterflies and Moths: the one flying only by day, the other most usually on the wing in the night. They may be easily distinguished from each other by their horns or feelers: those of the butterfly being clubbed or knobbed at the end; those of the moth tapering finer and finer to a point. To express it technically—the feelers of butterflies are elevated: those of moths are filiform.[1]

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[1] Moths are distinguished from butterflies, among other characters, by having at the base of the under wings, near the anterior edge, a stiff bristle or hair which passes through a hook on the under side of the anterior wings and maintains them when at rest in a horizontal or somewhat inclined position. The most characteristic and distinctive mark of the *hawk-moths* is to be found in the form of the antennæ, which encrease in diameter from a slender base nearly to the apex, forming a prismatic, fusiform club, and usually terminating in a subulated point which is occasionally somewhat curved. This thickening of the antennæ upwards indicates affinity to the diurnal lepidoptera, but in most of their other properties they are more closely allied to the moths or nocturnal kinds. The wings are narrow and elongated, of a firm consistence, and never borne perpendicularly in repose, but either parallel to the plain of position or slightly deflexed. The suctorial trunk (*maxillæ*) is usually of great length, often equal to that of the whole body; and appears, at least in some instances, to be of a more simple structure than among butterflies, consisting only of a simple semi-cylindric canal. When, for example, that of the death's-head-moth, which is short and rigid, and so sharply pointed as to be able to pierce the skin of the hand, is cut across, only a single perforation of an oval shape is visible. The palpi embrace the base of the trunk, consist of three articulations, and are so densely invested with hairs and scales, that their jointed structure is not discernible till these are rubbed off. The eyes are large, globose, and prominent, composed of a great number of facets. The tarsi are all divided into five joints; the intermediate tibiæ are furnished with two spines, and the hinder ones with four; and in the anterior pair, which are destitute of spines, there is a slender lobe lying along a part of the under side of the tibia, and attached to it by the upper extremity.

These insects constituted the genus *Sphinx* of Linnæus, and they compose the family named Crepuscularia by

The butterflies, as well as the moths, employ the short life assigned them in a variety of enjoyments. Their whole time is spent either in quest of food, which every flower offers; or in pursuit of the female, whose approach they can often perceive at two miles' distance. Their sagacity in this particular is not less astonishing than true; but by what

Latreille. The latter term has been applied to them, because many of the most conspicuous species are observed on the wing chiefly during the morning and evening twilight; others, however, do not shun the "garish eye of day," but may be seen darting about in the sunshine in company with butterflies and other exclusively diurnal kinds. Their flight is exceedingly rapid, and continued nearly in a direct line, somewhat like that of a bird, differing greatly in this respect from the devious zig-zag motion of most other lepidoptera, many of which seem to *float* rather than to be impelled by muscular exertion. The wings, notwithstanding, are rather of small size compared with the body; but the thickness and massiveness of the latter admits of great development in the muscles by which these organs are moved, and a momentum is thus communicated to them more than sufficient to compensate for their somewhat limited extent of surface. By their rapid vibration, the taper body of the insect is poised in the air like that of a hawk, while it hovers over the petals of a flower, and extracts the mellifluous juices by means of its long tubular proboscis. The resemblance just alluded to has caused them to be named hawk-moths; and as many of them, when thus hovering in the air, produce a humming sound, and in this respect, as well as in feeding on the wing and in the darting rapidity of their movements, bear some likeness to humming-birds, a few are named after these "winged gems," and are well known under the somewhat composite title of humming-bird hawk-moths.

The number of these insects found in Britain is not inconsiderable, and includes all the kinds indigenous to Europe, except a few species. Several conspicuous kinds have been admitted into our native lists, in consequence of the occurrence of one or two examples; but from what we know of their history and geographical distribution, it seems more proper to ascribe their appearance in this country to fortuitous causes,—such as accidental importation along with foreign productions, than to their being aboriginal natives of the soil.

Although *moths* (proper) may be characteristically said to be nocturnal insects, it must not be understood that their appearance is exclusively confined to the night, or even the twilight. The gamma-moth, the majority of the male bombycidæ, and others too numerous to mention, may often be seen "floating amid the liquid noon," associated with the multitude of other tribes which the sunshine awakes to active life and enjoyment. But with far the larger proportion, night is the chosen and appropriate season of activity. During the day they conceal themselves in clefts of trees, among tangled vegetation and under leaves, and seldom issue from their retreats till the light is beginning to fail. Some are on the wing only in the earlier part of the night, others are later in appearing, and continue their flight till the morning is far advanced. During these excursions many fall a prey to bats and night-birds of various kinds, which delight to capture their insect food when on the wing, seldom searching for it when at rest, according to the general practice of their day-feeding companions.

The great beauty of many of these insects, the almost infinite variety of their colours and markings, as well as their curious habits and economy, have long rendered this a favourite branch of study with the generality of entomologists. A large proportion of the works relating to insects, especially works of the illustrated class, are devoted to the elucidation of this tribe; and in almost every collection of indigenous specimens, they occupy a prominent place. The zeal with which the rarer and more beautiful kinds have been sought after, and the estimation in which they have been held when obtained, is sufficiently evinced by the high-sounding names, by means of which collectors have attempted to express their admiration. Such designations as the Emperor, Nonpareil, Kentish Glory, Richmond Beauty, &c. have been applied to them almost as liberally as similar names are used by the fanciers of gigantic gooseberries and peerless tulips, in reference to the objects of their predilection. In proportion to the eagerness shown in the pursuit, has been the variety of plans adopted to obtain specimens with the greatest ease and in the best possible condition. One of the most satisfactory methods is to rear the larvæ, when these can be obtained, till they change to pupæ, and the moths are thus secured as soon as they emerge, with the beauty of their plumage unimpaired. Mr Kirby mentions, that the seasons in which the London amateurs repair to the woods in search of larvæ, are the beginning of April, June, the beginning of July, and September; and they dig for the pupæ late in July, and in January and February. The perfect insects are to be found all the summer and autumn, and certain kinds even in winter. The attractions of a youthful female of their own species affords a means of procuring several of the larger Bombycidæ, even in places where they might not previously be supposed to exist. Advantage is often taken of the propensity which these insects show, in common with many other nocturnal animals, to repair to a light, when they may be readily seized as they continue to flutter around it in a kind of bewildered state. As the most effectual means of employing a light, it is recommended that it should be placed in a lanthorn, and the latter fixed on the breast by means of a belt around the waist, both hands being thus left at liberty. If indisposed, however, to make much personal exertion, the Aurelian may often reap a rich harvest merely by opening the windows of a lighted apartment, especially if his dwelling be in the vicinity of woods, and securing such visitors as make their appearance within. The following extract shows with what success this plan has been attended. "My success in obtaining lepidoptera, to which I am particularly attached," says the Rev. C. S. Bird, "I owe to the use of a lamp to attract moths. During the moonless nights of summer, I sit with a Sinumbra-lamp, and perhaps one or two smaller lamps, placed on a table close to the window. The moths speedily enter the room, if the weather be warm. I have had a levee of more than a hundred between the hours of ten and twelve. In the spring, too, and autumn, I have been frequently fortunate, though generally having my patience sufficiently tried. In March, for instance, I have taken many specimens of *Biston prodromarius* in one evening; *Glæa rubricosa* and *Lytæa leucographa* have accompanied them. In April and May, *Cucullia fissina* and *Peridæa serrata* have visited me. When November has arrived, *Petasia cassinea* and *Pœcilocampa populi* have crowded into my room. Of course, at such cool times of the year the window must be kept shut till the moths knock for admittance. If at any time of the year a warm mist pervade the air, there is almost a certainty of success. But should any one be induced by this account to try the lamp, he must make up his mind to experience more of unfavourable evenings than favourable. There is, however, this advantage in my sedentary plan of mothing, that it can be combined with reading or writing; and the intervals between the arrivals need not be lost. Moths are extremely sensible of any keenness in the air; a north or east wind is very likely to keep them from venturing abroad. Different species have different hours of flight. Thus, on a mild and dark

sense they are thus capable of distinguishing each other at such distances is not easy to conceive. It cannot be by the sight, since such small objects as they are, must be utterly imperceptible at half the distance at which they perceive each other: it can scarcely be by the sense of smelling, since the animal has no organs for that purpose. Whatever be their powers of perception, certain it is that the male, after having fluttered, as if carelessly about for some time, is seen to take wing, and go forward, sometimes for two miles together, in a direct line, to where the female is perched on a flower.

The general rule among insects is, that the female is larger than the male; and this obtains particularly in the tribe I am describing. The body of the male is smaller and slenderer; that of the female more thick and oval. Previous to the junction of these animals, they are seen sporting in the air, pursuing and flying from each other, and preparing, by a mock combat, for the more important business of their lives. If they be disturbed while

November evening, *Pœcilocampa populi* will occupy from seven to ten o'clock, after which it will make way for *Petasia cassinea*, which will fly till one or two in the morning. I have for experiment's sake, sat up in the summer till three o'clock, when the whole heaven was bright with the rising sun, and moths of various kinds have never ceased arriving in succession till that time. Some of them must come from a considerable distance. *Scotophila porphyrea*, being a heath moth, must come nearly a mile. Moths like butterflies, have their peculiar modes of flight, by which I can generally distinguish them on their entrance, before I can see their colours. Some announce themselves by a loud knock on the floor; this is the case with *Leiocampa dicæa*. Some ascend instantly to the ceiling, as *Agrotis corticea*. Many, I might say the majority, pass the lamp rapidly: and this shows the comparative inutility of using the lamp out of doors, where only those that loiter about it can be taken. Some have a soft and gentle flight; as, for instance, *Cosmia pyralina*, one of my most welcome visitors, whose entrance I am usually made aware of by seeing something drop down on the table, as quick as hail, but as light as a fleece of snow; whilst, on the contrary, the conceited vagaries and absurd violence of *Clisiocampa neustria* are absolutely amusing; and *cratægi* and *populi* are nearly as bad. It is not the *Nocturna* alone that come to me in the night—many of what Mr Stephens calls the *Semidiurna*, the *Geometridæ*, accompany them at all hours. It may likewise be worth while to say a word on my method of securing my prey. Suppose that, either with or without a *bag-net*, I have imprisoned a moth under an inverted wine-glass, I then light a small piece of German tinder, half the size of a sixpence, or less, and introduce it under the edge, and by means of the smoke the insect is stupified almost immediately. It is then wholly in my power, though it would quickly revive:—I pierce it; and, by means of a pin dipped in oxalic acid, and thurst into the body beneath the thorax, I prevent its revival, and fix it on the settling board. The German tinder does not injure the colour, as brimstone would, whilst it puts the moth so completely in my power for a few moments, that the specimens I thus take and kill are often as perfect and beautiful as if I had bred them. Of course, I use it for insects taken in the day, or bred, as well as for those captured by the lamp." The locality to which the above account refers is the vicinity of Reading in Berkshire. The list given by Mr Bird of the species taken in the manner described, includes many of the rarer and most beautiful kinds found in this country.

Another method of capturing moths has recently been practised in the north of England by P. J. Selby, Esq. of Twizel, and has been attended with so much success, that we have much pleasure in being enabled to subjoin the following account of it as communicated by that distinguished naturalist. "In the course of my entomological pursuits—for that fascinating department of Zoology has for the last year engrossed a great part of my leisure,—my attention was first directed to the mode I have since adopted for the capture of nocturnal lepidoptera, by the extraordinary success that I understood had attended the exposure of a sugar-cask, recently emptied, in a favourable situation; and by means of which attraction a great variety of moths, some of them of very rare occurrence, had been secured. As sugar casks are not easily procured in this country, I bethought myself of some succedaneum, and it presently struck me that a beehive, or as it is generally called here, a *skep*, recently emptied of its honey, or well anointed with the same, might answer the purpose, as it was evident the insects were attracted by the saccharine matter and smell. I accordingly had one prepared, and the very first evening was convinced that it would prove a very efficient trap, as several moths of different species were seen and taken upon it. Unfortunately, the best part of the season was nearly over before I commenced operations, as it was not exposed till after the middle of August; but from the success I have had up to the present time, I am convinced it is one of the most effectual modes of obtaining the noctuidæ, and that many which would otherwise escape observation are thus to be obtained. Indeed, some of those I have already procured, I had never before met with in this district; and I dare say, but for this attractive trap, they would have remained long undiscovered, as some of them are in their force or full flight at a much later period than we are generally accustomed to look after moths. I anticipate a rich harvest during the ensuing spring and summer, not only of the noctuidæ, but also of the other large moths; the Geometridæ and smaller species I know come to it, as some of them have already been taken upon it. By this mode also, many interesting particulars relating to their natural history are likely to become known to us, such as the period of duration of different species, the proportion of males and females, &c. I find that in the early part of the season their duration is much shorter than at a later; in many of those occurring in August and September, it seldom exceeded two or three weeks; whereas such as did not appear till towards the end of October have continued till the present period, that is, nearly three months; as I have taken every mild evening specimens of *Clæa Satellitia* up to the 26th of January, and *Calocampa exoleta* as late as the 7th of the same month. The skep should be well anointed on the exterior with honey (the refuse will answer perfectly well), and should be supported on a forked stake about four feet from the ground, or so that the insect can be easily got at and enclosed in the flappers as they alight and settle upon it. In this way they may be taken in as fine and perfect condition as if they had been bred from the larvæ within doors. I generally select a sheltered situation and near to wood; of late I have had it near a service tree, whose berries I had previously observed attracted the moths. The following are a few of the species taken:—Agrotis suffusa, Pyrophila Tragopogonis, Pyrophila tetra, Glæa Vaccinii, Glæa spadicea, Apamea nictitans, Polia occulta, Polia Chi, Xanthia fulvago, Xanthia gilvago, Phlogophora meticulosa, several species of Hadena, Caradrina glareosa," &c. &c.—*Naturalist's Library. British Moths. By James Duncan, Edin.* 1836.

united, the female flies off with the male on her back, who seems entirely passive upon the occasion.

But the females of many moths and butterflies seem to have assumed their airy form for no other reason but to fecundate their eggs, and lay them. They are not seen fluttering about in quest of food or a mate: all that passes during their short lives, is a junction with the male of about half an hour; after which they deposit their eggs and die, without taking any nourishment, or seeking any. It may be observed, however, that in all the females of this tribe, they are impregnated by the male by one aperture, and lay their eggs by another.

The eggs of female butterflies are disposed in the body like a bed of chaplets; which, when excluded, are usually oval, and of a whitish colour: some, however, are quite round; and others flatted like a turnip. The covering, or shell of the egg, though solid, is thin and transparent: and in proportion as the caterpillar grows within the egg, the colours change, and are distributed differently. The butterfly seems very well instructed by nature in its choice of the plant, or the leaf, where it shall deposit its burthen. Each egg contains but one caterpillar: and it is requisite that this little animal, when excluded, should be near its peculiar provision. The butterfly, therefore, is careful to place her brood only upon those plants that afford good nourishment to its posterity. Though the little winged animal has been fed itself upon dew, or the honey of flowers, yet it makes choice for its young of a very different provision, and lays its eggs on the most unsavoury plants; the rag-weed, the cabbage, or the nettle. Thus every butterfly chooses not the plant most grateful to it in its winged state; but such as it has fed upon in its reptile form.

All the eggs of butterflies are attached to the leaves of the favourite plant, by a sort of size or glue; where they continue unobserved, unless carefully sought after. The eggs are sometimes placed round the tender shoots of plants, in the form of bracelets, consisting of above two hundred in each, and generally surrounding the shoot like a ring upon a finger. Some butterflies secure their eggs from the injuries of air, by covering them with hair plucked from their own bodies, as birds sometimes are seen to make their nests: so that their eggs are thus kept warm, and also entirely concealed.

All the tribe of female moths lay their eggs a short time after they leave the aurelia; but there are many butterflies that flutter about the whole summer, and do not think of laying till the winter begins to warn them of their approaching end: some even continue the whole winter in the hollows of trees, and do not provide for posterity until the beginning of April, when they leave their retreats, deposit their eggs, and die. Their eggs soon begin to feel the genial influence of the season: the little animals burst from them in their caterpillar state, to become aurelias and butterflies in their turn, and thus to continue the round of nature.

CHAP. IV.

OF THE ENEMIES OF THE CATERPILLAR.

Nature, though it has rendered some animals surprisingly fruitful, yet ever takes care to prevent their too great increase. One set of creatures is generally opposed to another: and those are chiefly the most prolific that are, from their imbecility, incapable of making any effectual defence. The caterpillar has, perhaps, of all other animals, the greatest number of enemies; and seems only to exist by its surprising fecundity. Some animals devour them by hundreds; others more minute, yet more dangerous, mangle them in various ways; so that, how great soever their numbers may be, their destroyers are in equal proportion. Indeed, if we consider the mischiefs these reptiles are capable of occasioning, and the various damages we sustain from their insatiable rapacity, it is happy for the other ranks of nature, that there are thousands of fishes, birds, and even insects, that live chiefly upon caterpillars, and make them their most favourite repast.

When we described the little birds that live in our gardens, and near our houses, as destructive neighbours, sufficient attention was not paid to the services which they are frequently found to render us. It has been proved, that a single sparrow and its mate, that have young ones, destroy above three thousand caterpillars in a week; not to mention several butterflies in which numberless caterpillars are destroyed in embryo. It is in pursuit of these reptiles that we are favoured with the visits of many of our most beautiful songsters, that amuse us during their continuance, and leave us when the caterpillars disappear.

The maxim which has often been urged against man, that he, of all other animals, is the only creature that is an enemy to his own kind, and that the human species only are found to destroy each other, has been adopted by persons who never considered the history of insects. Some of the caterpillar kind, in particular, that seem fitted only to live upon leaves and plants, will, however, eat each other;

and the strongest will devour the weak in preference to their vegetable food. That which lives upon the oak is found to seize any of its companions, which it conveniently can, by the first rings, and inflict a deadly wound: it then feasts in tranquillity on its prey, and leaves nothing to the animal but the husk.

But it is not from each other they have the most to fear, as in general they are inoffensive; and many of this tribe are found to live in a kind of society. Many kinds of flies lay their eggs either upon or within their bodies; and, as these turn into worms, the caterpillar is seen to nourish a set of intestine enemies within its body, that must shortly be its destruction: Nature having taught flies, as well as all other animals, the surest methods of perpetuating their kind.—"Towards the end of August," says Reaumur, "I perceived a little fly, of a beautiful gold colour, busily employed in the body of a large caterpillar, of that kind which feeds upon cabbage. I gently separated that part of the leaf on which these insects were placed, from the rest of the plant, and placed it where I might observe them more at ease. The fly, wholly taken up by the business in which it was employed, walked along the caterpillar's body, now and then remaining fixed to a particular spot. Upon this occasion, I perceived it every now and then dart a sting, which it carried at the end of its tail, into the caterpillar's body, and then draw it out again, to repeat the same operation in another place. It was not difficult for me to conjecture the business which engaged this animal so earnestly; its whole aim was to deposit its eggs in the caterpillar's body; which was to serve as a proper retreat to bring them to perfection. The reptile thus rudely treated, seemed to bear all very patiently, only moving a little when stung too deeply; which, however, the fly seemed entirely to disregard. I took particular care to feed this caterpillar; which seemed to me to continue as voracious and vigorous as any of the rest of its kind. In about ten or twelve days, it changed into an aurelia, which seemed gradually to decline, and died: upon examining its internal parts, the animal was entirely devoured by worms; which, however, did not come to perfection, as it is probable they had not enough to sustain them within."

What the French philosopher perceived upon this occasion is every day to be seen in several of the larger kinds of caterpillars, whose bodies serve as a nest to various flies, that very carefully deposit their eggs within them. The large cabbage caterpillar is so subject to its injuries, that, at certain seasons, it is much easier to find them with than without them. The ichneumon fly, as it is called, particularly infests these reptiles, and prevents their fecundity. This fly is of all others the most formidable to insects of various kinds. The spider, that destroys the ant, the moth, and the butterfly, yet often falls a prey to the ichneumon; who pursues the robber to his retreat, and despising his net, tears him in pieces, in the very labyrinth he has made. This insect, as redoubtable as the little quadruped that destroys the crocodile, has received the same name; and from its destruction of the caterpillar tribe, is probably more serviceable to mankind. This insect, I say, makes the body of the caterpillar the place for depositing its eggs, to the number of ten, fifteen or twenty. As they are laid in those parts which are not mortal, the reptile still continues to live and to feed, showing no signs of being incommoded by its new guests. The caterpillar changes its skin, and sometimes undergoes the great change into an aurelia: but still the fatal intruders work within, and secretly devour its internal substance: soon after they are seen bursting through its skin, and moving away, in order to spin themselves a covering, previous to their own little transformation. It is indeed astonishing sometimes to see the number of worms, and those pretty large, that thus issue from the body of a single caterpillar and eat their way through its skin: but it is more extraordinary still that they should remain within the body, devouring its entrails, without destroying its life. The truth is, they seem instructed by nature not to devour its vital parts; for they are found to feed only upon that fatty substance which composes the largest part of the caterpillar's body. When this surprising appearance was first observed, it was supposed that the animal thus gave birth to a number of flies different from itself; and that the same caterpillar sometimes bred an ichneumon, and sometimes a butterfly: but it was not till after more careful inspection it was discovered, that the ichneumon tribe were not the caterpillar's offspring, but its murderers.

CHAP. V.

OF THE SILKWORM.

Having mentioned, in the last chapter, the damages inflicted by the caterpillar tribe, we now come to an animal of this kind, that alone compensates for all the mischief occasioned by the rest. This little creature, which only works for itself, has been made of the utmost service to man; and furnishes him with a covering more beautiful than any other animal can supply. We may declaim indeed against the luxuries of the times, when silk is so generally worn; but were such garments

to fail, what other arts could supply the deficiency?

Though silk was anciently brought in small quantities to Rome [1] yet it was so scarce as to be sold for its weight in gold; and was considered as such a luxurious refinement in dress, that it was infamous for a man to appear in habits of which silk formed but half the com-

[1] Silk was very little known at Rome till the reign of Augustus, and during a long succeeding period it remained extremely costly, only a small quantity reaching the imperial city by a circuitous and expensive land and water carriage. The increasing luxury of the Roman people caused the demand for silk manufacture to increase much faster than the supply, and the price became exorbitantly high.

Two monks, engaged as missionaries in China, succeeded in obtaining a quantity of silkworms' eggs, which they concealed in a hollow cane; and at length in the year 552, they conveyed them in safety to Constantinople. The eggs were hatched in the proper season by the warmth of manure; and the worms were fed with the leaves of the wild mulberry-tree. These worms in due time spun their silk, and propagated under the careful tendence of the monks, who also instructed the Romans in the whole process of manufacturing their production. The insects thus produced were the progenitors of the generations of silkworms which have since been reared in Europe and the western parts of Asia. Thus, a caneful of the eggs of an oriental insect became the means of establishing a manufacture which fashion and luxury have rendered so important.

The mulberry-tree was then eagerly planted in Europe, for the nourishment of these valuable insect labourers; and on this, their natural food, they were successfully reared in different parts of Greece.

The Venetians soon after this time opened commercial relations with the Greek empire, and continued for many centuries the channel for supplying the western parts of Europe with silks. The estimation in which this manufacture was held, continued sufficiently high for it to be considered worthy of being made a regal gift: it appears that in the year 790, the Emperor Charlemagne gave two silken vests to Offa, king of Mercia.

Although at this period the Roman empire was fast declining, they alone possessed the valuable breed of silkworms, which 600 years before had been transferred from the remotest extremity of the East; and none others had manufactured its costly spoils. Roger I., king of Sicily, led into captivity a considerable number of silk-weavers, whom he compulsorily settled in Palermo, obliging them to impart to his subjects the knowledge of their art. In twenty years from this forcible establishment of the manufacture, the silks of Italy are described as having obtained a decided excellence, being of diversified patterns and colours: some fancifully interwoven with gold. By degrees the manufacture spread over the greater part of Italy, and was carried into Spain; and in the reign of Francis I., took root in France.

A still longer interval occurred before its adoption into England, and its introduction was very slow, till the beginning of the sixteenth century. Bologna was the only city of Italy which possessed proper throwing mills, or the machinery necessary for twisting and preparing silken fibres for weaving.

The business of a silk-factory was considered a noble employment in Venice, and might be followed without degradation by the higher classes.

The silk trade made very little progress in France till the reign of Francis I., who procured artisans from Milan, and introduced them into Lyons. The French then made rapid progress in this pursuit; and, in addition to those of Lyons, many manufactories were speedily started in the southern provinces; supplying sufficient for their own consumption, and soon afterwards a superabundance for competition in foreign markets; furnishing many parts of Europe with the fruits of their newly-cultivated art; deriving great wealth from prosecuting this branch of trade with England. Queen Elizabeth, in the third year of her reign, 1560, was gratified by being presented with a pair of knitted black silk stockings by Mrs Montague, her silk woman; at which she was so delighted that she never afterwards condescended to wear those of cloth. Sir Thomas Gresham presented Edward VI. with a pair of long Spanish silk stockings, and, from their rarity, this offering was deemed worthy of much notice.

When Antwerp was captured by the Duke of Parma, in 1585, it was consigned during three days to indiscriminate plunder and destruction; and about a third part of their artisans and merchants who wrought and dealt in silk, took refuge in England, where they finally settled, and taught those arts by which they had long prospered in their native land, by which means the manufacture was materially improved in this country.

Every attempt at rearing silk-worms and producing silk having, after endless trials, failed, attention was directed to the establishments for producing both raw and wrought silks in the settlements at British India; where proximity to the country of its original production, the fitness of the climate, and, above all, the cheapness of labour, have contributed to insure complete success. The island of Cossimbuzar and its neighbourhood, in the province of Bengal, are particularly favourable to the labours of the silkworm. There are at this time eight principal silk-filatures, the produce of eight factories, belonging to the East India Company, in Bengal. In every filature there are employed, according to its size, from 3000 to 10,000 people; and if to these were added the mulberry-planters, worm feeders, &c., the number dependent on each establishment, would be from 10,000 to 40,000 men, women, and children. Silk requires so much care and attention for its production, and so great a number of persons must be employed in an establishment for rearing silkworms, that it is only in countries where the number of the poorer classes is in great proportion to capital, and therefore labour very cheap, that silk can be reared at an expense which offers successfully to compete with other countries. The silk, consumed in England alone, exceeds four millions of pounds in a year. Fourteen thousand millions of animated creatures annually live and die to supply this little corner of the world with an article of luxury. The importation of raw silk from China in 1829 amounted to 600,000 lbs.

A Lyons newspaper in 1812 states that there were 10,720 looms, employing 15,506 workmen. In 1824 there were 24,000 looms employing 36,000 hands.

In the year 1685, the revocation of the edicts of Nantes compelled many merchants, manufacturers, and artificers, to fly from France. About 70,000 made their way to England and Ireland; many of them resorted to Spitalfields, contributing much by their knowledge and skill to the improvement of the silk manufacture. To them we are indebted for the art of manufacturing brocades, satins, black and coloured mantuas, black paduasoys, ducates, watered satins, and velvets, all of which fabrics had been imported up to the year 1718. Our machinery being very defective, we were in a great degree dependent on the throwsters of Italy for a supply of organzine; but at that time, Mr Lombe, of Derby, having, in the disguise of a common workman, succeeded in taking accurate drawings of the throwing machinery in Piedmont, erected a stupendous mill for that purpose on the river Derwent, at Derby, and obtained a patent for the sole and exclusive property in the same for fourteen years. This grand machine was constructed with 26,586

position. It was most probably brought among them from the remotest parts of the East; since it was, at the time of which I am speaking, scarcely known even in Persia.

Nothing can be more remote from the truth, than the manner in which their historians describe the animal by which silk is produced. Pausanias informs us, that silk came from the country of the Seres, a people of Asiatic Scythia; in which place an insect as large as the beetle, but in every other respect resembling a spider, was bred up for that purpose. They take great care, as he assures us, to feed and defend it from the weather; as well during the summer's heat as the rigours of winter. This insect, he observes, makes its web with its feet, of which it has eight in number. It is fed for the space of four years upon a kind of paste, prepared for it; and at the beginning of the fifth, it is supplied with the leaves of the green willow, of which it is particularly fond. It then feeds till it bursts with fat; after which they take out its bowels, which are spun into the beautiful manufacture so scarce and costly.

The real history of this animal was unknown among the Romans till the time of Justinian; and it is supposed, that silk-worms were not brought into Europe till the beginning of the twelfth century; when Roger, of Sicily, brought workmen in this manufacture from Asia Minor, after his return from his expedition to the Holy Land, and settled them in Sicily and Calabria. From these the other kingdoms of Europe learned this manufacture; and it is now one of the most lucrative carried on among the southern provinces of Europe.

The silkworm is now very well known to be a large caterpillar, of a whitish colour, with twelve feet, and producing a butterfly of the moth kind.[1] The cone on which it spins, is formed for covering it while it continues in the aurelia state; and several of these, properly wound off, and united together, form those strong and beautiful threads which are woven

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wheels, and 97,746 movements, which worked 73,726 yards of organzine thread with every revolution of the water-wheel, whereby the machinery was actuated. So rapid was the growth of the silk trade from this time, that in 1783 the estimated value of silk goods manufactured in England was £3,350,000.

A great improvement had been effected (ten years before, viz. 1772) in Bengal raw silk. Better machinery being brought into use on the Italian system, and competent persons employed as heads of each factory. The shipments about this period, being from 515,000 to 560,000 lbs., have steadily increased to 1,500,000 lbs. annually. In Italy there is but one regular crop in the year; while in Bengal there are three at intervals of four months, March, July, and November.

[1] The *silkworm*, like all other insects of the same class, undergoes a variety of changes during the short period of its life; assuming, in each of its three successive transformations, a form wholly dissimilar to that with which it was previously invested.

We will proceed to trace the changes which it undergoes, commencing with the egg, which is about the size of a grain, and of a yellow colour, when fresh; but after a few days, become rather dark, of a bluish cast. The period which the egg requires is dependent on the temperature of the climate; so much so, that some eggs may be preserved during the winter and spring; or they may be quickened by artificial means, when the natural food appears in sufficient quantity for their support.

When hatched, it appears as a black worm, about a quarter of an inch in length, gradually becomes larger and whiter, and in about eight days its head enlarges and it is attacked by illness, which lasts for three days; refusing food, and remaining in a state of lethargy. This illness is supposed to be on account of the smallness of the skin. The worm appears at the end of the third day much wasted, and throwing off a kind of humour, which has exuded between its body and the skin about to be cast off, at the same time emits from its body silken cords, so as to fasten the abandoned skin to a spot whilst the insect forsakes it, which it performs in the following manner. It first rubs its head among the leafy fibres, so as to disencumber itself of the scaly covering, and then breaks through that part of the skin nearest the head. This action causes the larva very great exertion. Soon afterwards, it disengages its fore feet, and then the body is quickly drawn from the skin, which remains stationary. This operation occupies two or three minutes. The insect then begins to feed with renewed vigour and health. The skin sometimes refuses to separate from the body; in which case, the pressure occasions swelling and inflammation, and generally terminates in death.

Those worms which have recently shed their skin, are easily known from the others, by the pale colour and wrinkled appearance of their new skin. The larva changes its skin five separate times; and, on each occasion, increases in size and weight, as may be seen in following table.

	Inches.	Take to an ounce.
When born	¼	54,526
One moult	⅜	3,840
Two	⅝	610
Three	1¼	144
Four	2	35
Five	2½ to 3	6

Thus, in the space of a few short weeks, the worm increases in weight more than nine thousand times.

The annexed figures represent the worm in its last stage, the chrysalis, and the cocoon.



The caterpillar, having arrived at its last moult, devours its food most voraciously, and for ten days continues increasing in size; so that its structure can be better explained than in its former stages. It is now about three inches in length, and is composed of twelve membranous rings; the head is scaly, hard, and tapering; the mouth is horizontal; it has sixteen feet, six of which are placed in front, armed with claws, on the three rings nearest to the head; the other ten feet are placed behind, eight of which are on the sixth to the ninth, and two on the last

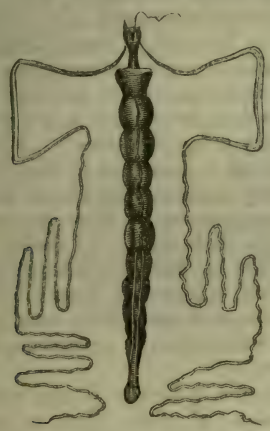
into silk. The feeding these worms, the gathering, the winding, the twisting, and the weaving their silk, is one of the principal manufactures of Europe; and, as our luxuries increase, seems every day to become more and more necessary to human happiness.

There are two methods of breeding silkworms; for they may be left to grow, and to remain at liberty upon the trees where they are hatched; or they may be kept in a place built for that purpose, and fed every day with fresh leaves. The first method is used in

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ring. These feet may be termed holders. There is also a kind of tail on the upper part of the last ring but one.

At the end of the period above stated, the worm's desire for food begins to lessen, though it continues to nibble the leaves, which it scatters about; its colour is now of a light green; it is very restless and uneasy, erects its head, and moves from side to side in a circular manner, seeking a corner where it can commence its labour of forming its cocoon, before which, however, the



body becomes firmer, more glossy, and somewhat transparent towards its head; it also lessens in size.

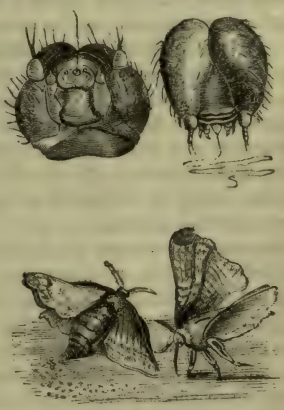
It may not be out of place to mention here from whence the silk proceeds;—The silk is secreted in the form of a fine yellow gum, in two long slender vessels, one on each side of the body. This silky material, when drawn from the orifices beneath the mouth, appears to be one thread, but is, in fact, composed of two fibres, which are extracted from the orifices, and brought together by means of two hooks placed in the mouth.

The worm, having fixed upon some corner that will suit its purpose, commences the labour by spinning thin and irregular threads, so as to support its future dwelling; it then forms upon these a loose structure of an oval shape, which is called floss silk; in the three following days it forms a firm and consistent yellow ball, the anterior of which is smeared with a peculiar gum, so as to shield it against the rain and various changes of temperatures. The filament is not spun in regular concentric circles, but in stops, going backwards and forwards with a sort of waving motion, which the worm effects by means of its fore feet while it remains in the interior.

Isnard, an old author, affirms, that the length of the silk of one cocoon, when drawn out, will measure six miles, that is, 10,565 yards; but Count Dandolo says, the probable length is 625 yards; other authors state it to be about 400 yards, while Pullein says the average length is 300 yards. The latter author thus writes:—"There is scarcely anything among the various wonders which the animal creation affords, more admirable than the variety of changes which the silkworm undergoes; but the curious texture of that silken covering with which it surrounds itself, when it arrives at the perfection of its animal life, vastly surpasses what is made by other animals of this class. All the caterpillar kind do, indeed, undergo changes like those of the silkworm, and the beauty of them in their butterfly state greatly exceeds it; but the covering which they put on before this change into a fly is poor and mean, when compared to that golden tissue in which the silkworm wraps itself. They, indeed, come forth in a variety of colours, their wings bedropped with gold and scarlet, yet are they but the beings of a summer's day; both their life and beauty quickly vanish, and they leave no remembrance after them, but the silkworm leaves behind it such beautiful, such beneficial monuments, as at once record both the wisdom of their Creator and his bounty to man."

The worm, having finished its cocoon, rests awhile from its labour, and at the same time decreases in size and bulk; it then throws off its last skin, and undergoes its metamorphosis into a chrysalis, which is of a chestnut colour, and smooth. The time during which the insect remains in this state of lethargy is generally from fifteen to thirty days, as it is influenced by the temperature of the climate in which this metamorphosis is about to take place, viz. in England it requires thirty days, in France twenty-one, in Spain and Italy eighteen to twenty, and in India only eleven days.

After the above stated periods the insect breaks through the upper end of the cocoon, by emitting a liquid from its mouth, which moistens the gum with which it has lined the interior of its chamber. After this operation, it appears as the perfect insect, with four wings of a grayish white colour, with two transverse undulated bands on



the fore and wings. The stationary and sluggish habits of these moths are not entirely owing, as is generally supposed, to the insect being confined within certain limits during the period of several generations; as these habits are also common to others of the same family, which are only found in certain local districts; and thus proves that this valuable insect partakes of the same mode of life in the domestic as in the wild or natural state. Their life continues for the short period of two or three days, in which time they are wholly occupied in securing the continuance of their kind. Various accounts are given as to the number of eggs which the female lays, some stating 250, while others mention 400 to 500 as the usual number.—*Natural History of Insects, London*, 1835. *Vol. II.*

China, Tonquin, and other hot countries; the other is used in those places where the animal has been artificially propagated, and still continues a stranger. In the warm climates, the silkworm proceeds from an egg, which has been glued by the parent moth upon proper parts of the mulberry-tree, and which remains in that situation during the winter. The manner in which they are situated and fixed to the tree, keeps them unaffected by the influence of the weather; so that those frosts which are severe enough to kill the tree, have no power to injure the silkworm.

The insect never proceeds from the egg till Nature has provided it a sufficient supply; and till the budding leaves are furnished, in sufficient abundance, for its support. When the leaves are put forth, the worms seem to feel the genial summons, and bursting from their little eggs, crawl upon the leaves, where they feed with a most voracious appetite. Thus they become larger by degrees; and after some months' feeding, they lay, upon every leaf, small bundles or cones of silk, which appear like so many golden apples, painted on a fine green ground. Such is the method of breeding them in the East; and without doubt it is the best for the worms, and least troublesome for the feeder of them. But it is otherwise in our colder European climates; the frequent changes of the weather, and the heavy dews of our evenings, render the keeping them all night exposed, subject to so many inconveniences, as to admit of no remedy. It is true, that, by the assistance of nets, they may be preserved from the insults of birds; but the severe cold weather, which often succeeds the first heats of summer, as well as the rain and high winds, will destroy them all: and, therefore, to breed them in Europe, they must be sheltered and protected from every external injury.

For this purpose, a room is chosen, with a south aspect; and the windows are so well glazed as not to admit the least air: the walls are well built, and the planks of the floor exceedingly close, so as to admit neither birds nor mice, nor even so much as an insect. In the middle there should be four pillars erected, or four wooden posts, so placed as to form a pretty large square. Between these are different stories made with osier hurdles; and under each hurdle there should be a floor with an upright border all round. These hurdles and floors must hang upon pullies, so as to be placed or taken down at pleasure.

When the worms are hatched, some tender mulberry leaves are provided, and placed in the cloth or paper-box in which the eggs were laid, and which are large enough to hold a great number. When they have acquired some strength, they must be distributed on beds of mulberry leaves, in the different stories of the square in the middle of the room, round which a person may freely pass on every side. They will fix themselves to the leaves, and afterwards to the sticks of the hurdles, when the leaves are devoured. They have then a thread, by which they can suspend themselves on occasion, to prevent any shock by a fall; but this is by no means to be considered as the silk which they spin afterwards in such abundance. Care must be taken that fresh leaves be brought every morning, which must be strewed very gently and equally over them; upon which, the silkworms will forsake the remainder of the old leaves, which must be carefully taken away, and every thing kept very clean; for nothing hurts these insects so much as moisture and uncleanliness. For this reason their leaves must be gathered when the weather is dry, and kept in a dry place, if it be necessary to lay in a store. As these animals have but a short time to live, they make use of every moment, and almost continually are spinning, except at those intervals when they change their skins. If mulberry leaves be difficult to be obtained, the leaves of lettuce, or hollyhock, will sustain them; but they do not thrive so well upon their new diet; and their silk will neither be so copious, nor of so good a quality.

Though the judicious choice and careful management of their diet is absolutely necessary, yet there is another precaution of equal importance; which is, to give them air, and open their chamber windows, at such times as the sun shines warmest. The place also must be kept as clean as posible; not only the several floors that are laid to receive their ordure, but the whole apartments in general. These things well observed, contribute greatly to their health and increase.

The worm, at the time it bursts the shell, is extremely small, and of a black colour; but the head is of a more shining black than the rest of the body: some days after, they begin to turn whitish, or of an ash-coloured gray. After the skin begins to grow too rigid, or the animal is stinted within it, the insect throws it off, and appears clothed anew: it then becomes larger, and much whiter, though it has a greenish cast; after some days, which are more or less, according to the different heat of the climate, or to the quality of the food, it leaves off eating, and seems to sleep for two days together: then it begins to stir, and put itself into violent motions, till the skin falls off the second time, and is thrown aside by the animal's feet. All these changes are made in three weeks or a month's time; after which it begins to feed once more, still in its caterpillar form, but a good deal differing from itself before its change. In a few days'

time it seems to sleep again; and, when it awakes, it again changes its clothing, and continues feeding as before. When it has thus taken a sufficiency of food, and its parts are disposed for assuming the aurelia form, the animal forsakes, for the last time, all food and society, and prepares itself a retreat to defend it from external injuries, while it is seemingly deprived of life and motion.

This retreat is no other than its cone, or ball of silk, which Nature has taught it to compose with great art; and within which it buries itself, till it assumes its winged form. This cone or ball is spun from little longish kinds of bags that lie above the intestines, and are filled with a gummy fluid, of a marigold colour. This is the substance of which the threads are formed; and the little animal is furnished with a surprising apparatus for spinning it to the degree of fineness which its occasions may require. This instrument in some measure resembles a wire-drawer's machine, in which gold or silver threads are drawn to any degree of minuteness; and through this the animal draws its thread with great assiduity. As every thread proceeds from two gum-bags, it is probable that each supplies its own; which however, are united, as they proceed from the animal's body. If we examine the thread with a microscope, it will be found that it is flatted on one side, and grooved along its length: from hence we may infer, that it is doubled just upon leaving the body: and that the two threads stick to each other by that gummy quality of which they are possessed. Previous to spinning its web, the silkworm seeks out some convenient place to erect its cell, without any obstruction. When it has found a leaf, or a chink fitted to its purpose, it begins to wreathe its head in every direction, and fastens its thread on every side to the sides of its retreat. Though all its first essays seem perfectly confused, yet they are not altogether without design: there appears, indeed, no order or contrivance in the disposal of its first threads; they are by no means laid artfully over each other, but are thrown out at random, to serve as an external shelter against rain; for nature having appointed the animal to work upon trees in the open air, its habits remain, though it is brought up in a warm apartment.

Malpighi pretends to have observed six different layers in a single cone of silk: but what may easily be observed is, that it is composed externally of a kind of rough cotton-like substance, which is called floss; within, the thread is more distinct and even; and next the body of the aurelia, the apartment seems lined with a substance of the hardness of paper, but of a much stronger consistence. It must not be supposed, that the thread which goes to compose the cone, is rolled round, as we roll a bottom; on the contrary, it lies upon it in a very irregular manner, and winds off now from one side of the cone, and then from the other. This whole thread, if measured, will be found about three hundred yards long; and so very fine, that eight or ten of them are generally rolled off into one by the manufacturers. The cone, when completed, is in form like a pigeon's egg, and more pointed at one end than the other: at the smaller end, the head of the aurelia is generally found: and this is the place that the insect, when converted into a moth, is generally seen to burst through.

It is generally a fortnight or three weeks before the aurelia is changed into a moth; but no sooner is the winged insect completely formed, than having divested itself of its aurelia skin, it prepares to burst through its cone, or outward prison: for this purpose it extends its head towards the point of the cone, butts with its eyes, which are rough, against the lining of its cell, wears it away, and at last pushes forward, through a passage which is small at first, but which enlarges as the animal increases its efforts for emancipation; while the tattered remnants of its aurelia skin lie in confusion within the cone, like a bundle of dirty linen.

The animal, when thus set free from its double confinement, appears exhausted with fatigue, and seems produced for no other purpose but to transmit a future brood. It neither flies nor eats; the male only seeking the female, whose eggs he impregnates; and their union continues for four days, without interruption. The male dies immediately after separation from his mate; and she survives him only till she has laid her eggs, which are not hatched into worms till the ensuing spring.

However, there are few of these animals suffered to come to a state of maturity; for as their bursting through the cone destroys the silk the manufacturers take care to kill the aurelia, by exposing it to the sun, before the moth comes to perfection. This done, they take off the floss, and throw the cones into warm water, stirring them till the first thread offers them a clue for winding all off. They generally take eight of the silken threads together; the cones being still kept under water, till a proper quantity of the silk is wound off: however, they do not take all; for the latter parts grow weak, and are of a bad colour. As to the paper-like substance which remains, some stain it with a variety of colours, to make artificial flowers; others let it lie in the water, till the glutinous matter which cements it is all dissolved: it is then carded like wool, spun with a wheel, and converted into silk stuffs of an inferior kind.

HISTORY OF INSECTS, &c.

BOOK IV.

INSECTS OF THE FOURTH ORDER.

CHAP. I.

OF THE FOURTH ORDER OF INSECTS IN GENERAL.

In the foregoing part we treated of caterpillars changing into butterflies; in the present will be given the history of grubs changing into their corresponding winged animals. These, like the former, undergo their transformation, and appear as grubs or maggots, as aurelias, and at last as winged insects. Like the former, they are bred from eggs; they feed in their reptile state; they continue motionless and lifeless, as aurelias; and fly and propagate, when furnished with wings. But they differ in many respects: the grub or maggot wants the number of feet which the caterpillar is seen to have; the aurelia is not so totally wrapped up, but that its feet and its wings appear. The perfect animal, when emancipated, also has its wings either cased, or transparent like gauze; not coloured with that beautifully painted dust which adorns the wings of the butterfly.

In this class of insects, therefore, we may place a various tribe, that are first laid as eggs, then are excluded as maggots or grubs, then change into aurelias, with their legs and wings not wrapped up but appearing; and, lastly, assuming wings, in which state they propagate their kind. Some of these have four transparent wings, as bees; some have two membranous cases to their wings, as beetles; and some have but two wings, which are transparent as ants. Here, therefore, we will place the bee, the wasp, the humble-bee, the ichneumon fly, the gnat, the tipula or long legs, the beetle, the may-bug, the glow-worm, and the ant. The transformations which all these undergo, are pretty nearly similar; and though very different animals in form, yet are produced nearly in the same manner.

CHAP. II.

OF THE BEE.

To give a complete history of this insect in a few pages, which some have exhausted volumes in describing, and whose nature and properties still continue in dispute, is impossible.[1] It will be sufficient to give a general idea of the animal's operations; which, though they have been studied for more than two thousand years, are still but incompletely known. The account given us by Reaumur is sufficiently minute; and, if true, sufficiently wonderful: but I find many of the facts which he relates, doubted by those who are most conversant with bees: and some of them actually declared not to have a real existence in nature.

It is unhappy, therefore, for those whose method demands a history of bees, that they are unfurnished with those materials which have induced so many observers to contradict so great a naturalist. His life was spent in

[1] Many works have been written on the nature and habits of bees. Among those who have contributed largely to our knowledge of the subject may be mentioned, Swammerdam, Reaumur, Schirach, Thorley, Wildman, Huish, Howison, Huber, and Bonner. The two latter made many valuable discoveries regarding the bee under very peculiar and, one would almost imagine, insurmountable disadvantages. Huber was stone blind, and Bonner's researches were conducted in the midst of a populous city, and during the pressure of daily toil,—he being a poor weaver, and his hives being kept for many years in a *garret* in the Gallowgate of Glasgow! Bonner's work on Bees was published at Edinburgh in 1795, (one volume, 8vo) and an English translation of Huber's was published in 1806, (12mo.)

the contemplation; and it requires an equal share of attention, to prove the error of his discoveries. Without entering, therefore, into the dispute, I will take him for my guide; and just mention, as I go along, those particulars in which succeeding observers have begun to think him erroneous. Which of the two are right, time only can discover; for my part, I have only heard one side, for as yet none have been so bold as openly to oppose Reaumur's delightful researches.

There are three different kinds of bees in every hive.[1] First, the labouring bees, which make up the far greatest number, and are thought to be neither male nor female, but merely born for the purposes of labour, and continuing the breed, by supplying the young with provision, while yet in their helpless state. The second sort are the drones; they are of a darker colour, longer, and more thick by one-third than the former; they are supposed to be the males; and there is not above a hundred of them in a hive of seven or eight thousand bees. The third sort is much larger than either of the former, and still fewer in number; some assert that there is not above

[1] *Functions of the inmates of a hive.*—A hive consists of the Queen, or mother-bee, the Workers varying in numbers, from 10,000, to 20,000 or 30,000, and the Males or Drones, from 700 to double that number.

Functions of the Queen.—The Queen is the parent



of the hive, and her sole province and occupation consist in laying the eggs, from which originate those prodigious multitudes that people a hive, and emigrate from it in the course of one summer. In the height of the season, her fertility is truly astonishing, as she lays not fewer than 200 eggs per day, and even more when the season is particularly warm and genial, and flowers are abundant; and this laying continues, though at a gradually diminishing rate, till the approach of cold weather in October. So early as February, she resumes her labours in the same department, and supplies the great blank made in the population by the numerous casualties that take place between the end of summer and commencement of spring. Her *great laying* of the eggs of workers begins generally about the fifth day of her age; and she continues to deposit eggs of the same kind for the succeeding eleven months; after which she commences laying those of males. It is during the depositing of these last, that the Bees are led by their instinct to lay the foundation of royal cells, in which, if the population be abundant, the Queen deposits eggs at intervals of one or two days between each. In the operation of laying, which we have a thousand times witnessed, the Queen puts her head into a cell, and remains in that position about a second or two, as if to ascertain whether it is in a fit state to receive the deposit. She then withdraws her head, curves her body downwards, inserts her abdomen into the cell, and turns half round on herself; having kept this position for a few seconds, she withdraws her body, having in the meantime laid an egg. The egg itself, which is attached to the bottom of the cell by a glutinous matter with which it is imbued, is of a slender oval shape, slightly curved, rather more pointed in the lower end than in the other. She passes on from cell to cell, furnishing each with the germ of a future inhabitant; and during these proceedings, she receives the most marked and affectionate attention from the workers. She is seen continually surrounded by a circle of them, who caress her fondly with their antennæ, and occasionally supply her with food from their probosces. This appearance has given rise to the notion commonly entertained, and asserted even by some Naturalists, that the Queen is followed in her progress through the hive by a number of her subjects formed in a circle round her, and these of course have been regarded as the Queen's *body guards*. The truth is, however, that her Bee-majesty has no attendants, strictly speaking; none who follow in her train; but wherever she moves, the workers whom she encounters in her progress instantly and hurriedly clear the way before her, and all turning their heads towards their approaching sovereign, lavish their caresses upon her with much apparent affection, and touch her softly with their antennæ; and these circumstances, which may be observed every hour in the day, in a properly constructed glass hive, have given rise to the idea of guards. The moment she has left the circle, the bees who had surrounded her instantly resume their labours, and she passes on, receiving from every group in her way the homage due to a Mother and a Queen

Functions of the Worker-Bee.—The workers, to the



number of 10,000, 20,000, and even 30,000, constitute the great mass of the population of a hive, and on them devolve the whole labours of the establishment. Theirs is the office of searching for and collecting the precious fluid which not only furnishes their daily food, as well as that of their young, and the surplus of which is laid up for winter stores, but also the materials from which they rear their beautiful combs. In the little basket-shaped cavity in their hind-legs, they bring home the pollen or farinaceous dust of flowers, kneaded by the help of the morning dew into tiny balls, which form an important ingredient in the nourishment of the brood; and also the propolis or adhesive gum extracted from willows, &c., with which they attach their combs to the upper part and sides of the hive, and stop every crevice that might admit the winter's cold. Exploring a glass hive in a soft spring morning, and following with his eye a bee loaded with farina, the observer will perceive the little active forager, on her arrival in the interior, hurrying over the surface of the comb in search of a proper cell in which to deposit her burden; and having found one, fastening herself by the two fore-feet on its superior border, then bending her body a little forward, that her hinder feet may catch hold of the opposite edge of the cell. In this position she is next seen thrusting back her second pair of feet, one on each side, and sweeping with them from top to bottom along the two hinder legs, where the farina balls are fixed, and by this means detaching them from the hairy linings of the cavities, and depositing them in the cell. To the workers, also, are committed the various offices of guarding the entrance

one in every swarm : but this later observers affirm not to be true, there being sometimes five or six in the same hive. These are called queen bees, and are said to lay all the eggs from which the whole swarm is hatched in a season.

In examining the structure of the common working bee, the first remarkable part that

of the hive by night and day, during the honey season ; of repulsing marauders ; of keeping their abode free from all offensive matters ; of renewing the air within by an ingenious mode of ventilation ; of replacing a lost Queen, and of destroying the drones at the decline of the honey season. Receiving from nature these weighty charges, they labour assiduously to fulfil them ; and, while each member of the community acts by the impulse of its individual instinct, it works less for private than for the general good. These labours appear unceasing ; yet do the weary labourers sometimes snatch an interval of repose. During the busy season, we have seen hundreds of the workers retiring into the cells, and exhibiting all the marks of profound sleep. This fact is very easily observable, especially in those cells which are constructed, as sometimes happens, against the glass, and where that substance forms one side of the cell. There they are, the fatigued labourers, stretched at full length, with their heads at the bottom, and every limb apparently in a relaxed state, while the little body is seen heaving gently from the process of respiration. Huber thinks he has ascertained that there are two kinds of workers in a hive, one of which he calls *Wax-workers*, and the other *Nurses*. The office of the first class, according to Huber, is not only to collect honey, which both kinds do, but also to elaborate the wax, and construct the combs. The particular function of the other, is to take care of the young. They may be distinguished in entering the hive, by carefully examining their shape ; the wax-workers having their bellies somewhat cylindrical, while those of the nurses retain their ovoidal figure. The anatomical structure of the two is said to be different, and the capacity of stomach not the same ; so that the one species is incapable of fulfilling all the functions of the other. Huber has also directed our attention to a class of workers, which he calls *Black Bees*, and which he first observed in 1809, and on several other occasions from that time to the year 1813. In every thing they bear a perfect resemblance to their fellow-workers, except in colour, which in them is a deep black. He describes them as persecuted by the other workers, and finally expelled the hives, or destroyed. We have noticed them, though rarely ; perhaps not more than one or two in a season. The other bees did not molest them, as far as we observed, nor indeed seem in any way sensible of their presence. It is not improbable, as Kirby and Spence conjecture, that they are merely *aged bees*, and that their deeper colour arises from the hair or down, with which the young are so thickly clothed, being worn off their bodies.

In describing the functions of the Working Bee, it would be improper to pass over unnoticed the fact, that it sometimes exercises the functions of a mother. To account for this apparent anomaly, we must remember that it has been ascertained by minutely accurate dissection, that all the workers are *females*, though of imperfect organization ; a fact confirmed by the very circumstance we are now discussing. We must also keep in mind, that the larva of a Queen is nourished with food of a different kind from that of common bees ; and this difference, in conjunction with a more roomy cell, has, in the opinion of naturalists, the effect of expanding the ovarium, and qualifying her to become a mother. It is evident, therefore, that, if the larva of a common bee were fed with the royal jelly, the imperfection in her bodily organs would, as far at least as depended on the nature of the food, be removed, and she would become capable of laying eggs. Now this does occasionally take place ; some of the royal food is dropped, probably by accident, into some of the cells adjoining that of the Queen, and the bees therein reared acquire the power of laying eggs. This fact was discovered by the naturalist Riem, and has been confirmed by Huber. There is, however, a very material and hitherto unaccounted for difference between these fertile workers and perfect Queens ; the former lay the eggs of *males* only. We would certainly have expected, *a priori*, that a difference between them *should* exist ; because the workers have fed on the royal jelly only for a short time, and because their birth-place is so much smaller. But we cannot easily conceive how these circumstances should be the cause of their laying only *male eggs*. In truth, it appears to be one of those mysteries in bee-economy, which, with all our researches on the subject, we cannot yet unravel. These fertile workers are never found in any hives but such as have lost their natural Queen.

The natural term of the worker's existence does not extend, we think, beyond six or eight months. It is the opinion of Dr Bevan that all the bees brought into existence at the Queen's great laying in spring die before winter. But many never reach that period. Showers of rain, violent blasts of wind, sudden changes of atmosphere, destroy them in hundreds. In the clear cold mornings and evenings of autumn, their eagerness for foraging entices them abroad early and late ; when, alighting on the ground, many are chilled, and quickly perish. And should they escape the blighting atmosphere at the close of autumn, a bright sunshine in a winter day, when the ground perhaps is covered with snow, brings them abroad in multitudes, and the half of them never return. From these causes, independent of the numbers which fall a prey to enemies, a swarm which in July amounted to fifteen or twenty thousand, will, by the following February or March, have dwindled to a mere handful. It is otherwise with the Queen ; going seldom abroad, she is little exposed to accidents. Her natural life is prolonged to several years, though the precise extent has not been accurately ascertained. In 1834 we had one in our possession, which we had every reason to believe was not less than four years old.

Functions of the Male or Drone.—The sole office of



the Male, or at least the primary one, is to pair with the Queen. He is the father of the hive. Indolent and luxurious, he takes no part in the internal operations of the domicile, and never leaves it with a view of sharing in the labours of the field. When he does venture abroad, it is only in the finest weather, and during the warmest part of the day, at which time the young Queens are instinctively led to go out in search of the male. He is easily distinguished from the workers by his larger size, by his heavy motion in flight, and by his loud humming sound. We have said that the primary function of the drones is to perpetuate the race of bees by pairing with the Queen, but some naturalists have assigned them a secondary office, namely, that of contributing by their numbers to the heat of the hive, and thus aiding in bringing the brood to maturity. In some parts of the

offers is the trunk, which serves to extract the honey from flowers. It is not formed, like that of other flies, in the manner of a tube, by which the fluid is to be sucked up; but like a besom to sweep, or a tongue to lick it away. The animal is furnished also with teeth, which serve it in making wax. This substance is gathered from flowers, like honey; it consists of that dust or farina which contributes to the fecundation of plants, and is moulded into wax

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continent, accordingly, Feburier tells us, they have received the name of *Hatchers*. There are occasionally found drones of a small size in hives where the impregnation of the Queen has been retarded. In such circumstances, her instinct is so impaired, that she lays her eggs indiscriminately in all kinds of cells; those of males sometimes in the cells of workers. The consequence is, that these males, when hatched, are diminutive in size, having been cramped in their growth by the smallness of their birth-place.

The life of this *vir gregis* is extremely short; the favoured lover perishes soon after his union with the female, and thus anticipates, though only by a short period, the destruction which awaits his race. So early as the beginning of August, the bees, as if wishing to apply "the preventive check" to a superabundant idle population, begin to manifest deadly intentions towards them; and the unfortunate victims, as if to derive consolation from one another's society, or perhaps driven together by their irascible superiors, may be seen about that period clustering closely together in some corner of the combs, where they remain without motion, and without once venturing to approach the provision-cells. Thus weakened by hunger and captivity, and disqualified for resistance by the want of a sting, they fall an easy prey to their merciless assailants; and a scene of carnage takes place which it is difficult to describe. The unhappy wretches are seen driven to the bottom of the hive pursued with such fury, that, in spite of their strength, which is greatly superior to that of their persecutors, and which enables them to drag two or three of their assailants along the board, and even to fly off with them, they are unable to avoid the mortal thrust of their formidable stings, and expire instantaneously from the effects of the poison. But death overtakes them in various forms; for their enemies sometimes seize them by the wings, and with their strong mandibles gnaw them at the roots, and disable them from flying. They may then be seen in numbers crawling on the ground, where they perish from the cold, or are trampled under foot, and devoured by birds or frogs. Such as escape for a while, may be seen flying from destruction, lighting on the shrubs and flowers to enjoy a moment's respite from their terrors; or buzzing about our windows, or wandering about from hive to hive, into one of which they no sooner enter than certain death awaits them. Nay, so bitter is the fury of their tormentors, that, not satisfied with destroying these unhappy beings themselves, they tear from the cells such of the doomed race as are yet in the state of larvæ, and sucking from their bodies, with instinctive economy, the fluids they contain, cast the lifeless remains out of the hive. There are cases, however, in which this destruction of males does not take place. "In hives that have lost their Queen," says Huber, "the males are spared; and, while a savage massacre rages in other hives, they here find an asylum. They are tolerated and fed, and many are seen even in the middle of January." The cause of this may perhaps be looked for in the additional heat which they would generate in winter; or perhaps they may be preserved for the purpose of pairing with a new Queen.

The impregnation of the Queen-bee is a branch of Natural History which has given rise to more discussion than almost any other fact, connected with the nature of the insect. And indeed the difficulty, we might almost say *impossibility* of obtaining any thing like ocular evidence on the subject, will readily account for the diversity of opinion that has hitherto prevailed. And we should hope that this difficulty alone, and not any preconceived theory or unreasonable prejudice, is the cause of that determined pertinacity with which the discoveries and conclusions of Huber, on this subject, are still in some instances rejected. That justly celebrated naturalist, instituted a set of experiments on the subject of the Queen's impregnation, the result of which leads to the conclusion that it takes place in the air.

There is a fact connected with this part of the natural history of the mother-bee which involves great difficulties. The fact itself was discovered by Huber, but its cause he was unable to develope, and no succeeding naturalist has been able to free it from the obscurity in which he has left it, we mean the effects of retarded impregnation. These effects are such as we could hardly credit, were not the fact confirmed by numerous experiments. If impregnation be delayed longer than twenty days from the Queen's birth, the consequence is, that none but male eggs are laid, even during the whole of the Queen's life. This phenomenon has baffled every attempt to explain its cause. "There are mysteries," observes Feburier, "in the operations of nature, both in reference to the rational and irrational creation, which will, probably, for ever remain inscrutable to man." In the natural state of things, that is, when fecundation has not been postponed, the Queen lays the eggs of workers in forty-six hours after her union with the male, and continues for the subsequent eleven months to produce these alone, and it is only after this period that a considerable laying of the eggs of drones commences. These male eggs require eleven months to attain to maturity, but, under the effects of retardation, they are matured in forty-six hours. The eggs of workers, which, in the usual state of things, would have been laid first, never come to light; their vitality has been destroyed by some vitiation which has taken place, and the cause of which has not yet been discovered. Huber, in reasoning on the subject, and contemplating the difficulty attending it, declares it to be "an abyss in which he is lost." There is another circumstance which he has not adverted to, and which seems to increase these difficulties. He asserts that before a Queen commences her *great* laying of male-eggs, she must be eleven months old. But he acknowledges that "a Queen hatched in spring, will perhaps lay fifty or sixty eggs of drones in whole, during the course of the ensuing summer." We know this to be true from our own experience; and also as the usual consequence of this appearance of male-eggs, that the bees commence building royal cells; the Queen lays in them, and swarming takes place. Now this partial laying of drone-eggs takes place only in the case of very early swarms; and if the weather be unfavourable, it does not happen even in them. But if in the natural state, the space of eleven months be necessary for the male-eggs to acquire that degree of increment they must have attained when laid, how are we to explain the fact of two or three score of these male-eggs making their appearance before the mother-bee is six weeks old? Leaving this matter in the obscurity which we cannot dispel, we have only further to observe, that in every case of retarded impregnation the instinct of the Queen appears to be greatly impaired. She lays her eggs indiscriminately in drone and worker cells; now and then even in royal cells; and does not evince that jealousy and irritable temperament towards her rivals, which, in the natural state, characterize the Queen.—*Naturalist's Library. Entomology. Vol.* vi. *Bees. Edinburgh*, 1840.

by the little animal at leisure. Every bee, when it leaves the hive to collect this precious store, enters into the cup of the flower, particularly such as seem charged with the greatest quantities of this yellow farina. As the animal's body is covered over with hair, it rolls itself within the flower, and soon becomes quite covered with the dust, which it soon after brushes off with its two hind-legs, and kneads into two little balls. In the thighs of the hind-legs there are two cavities, edged with hair, and into these, as into a basket, the animal sticks its pellets. Thus employed, the bee flies from flower to flower, increasing its store, and adding to its stock of wax; until the ball upon each thigh becomes as big as a grain of pepper: by this time, having got a sufficient load, it returns, making the best of its way to the hive.[1]

The belly of the bee is divided into six rings, which sometimes shorten the body, by slipping one over the other. It contains within it, beside the intestines, the honey-bag, the

[1] The celebrated John Hunter shrewdly remarked that the pellets of pollen seen on the thighs of bees are of different colours on different bees, while the shade of the new-made comb is always uniform; and therefore he concluded that pollen was not the origin of wax. Pollen also, he observed, is collected with greater avidity for old hives, where the comb is complete, than for those where it is only begun, which would hardly be the case were it the material of wax. He found that when the weather was cold and wet in June, so that a young swarm was prevented from going abroad, as much comb was constructed as had been made in an equal time when the weather was favourable and fine. The pellets of pollen on the thighs being thence proved not to be wax, he came to the conclusion that it was an external secretion originating between the plates of the belly. When he first observed this, he felt not a little embarrassed to explain the phenomenon, and doubted whether new plates were forming, or whether bees cast the old ones as lobsters do their shells. By melting the scales, he ascertained at least that they were wax; and his opinion was confirmed by the fact, that the scales are only to be found during the season when the combs are constructed. But he did not succeed in completing the discovery by observing the bees actually detach the scales, though he conjectured they might be taken up by others, if they were once shaken out from between the rings.

That wax is secreted, is proved both by the wax pouches within the rings of the abdomen, and by actual experiment. Huber and others fed bees entirely upon honey or sugar, and, notwithstanding, wax was produced and combs formed as if they had been at liberty to select their food. "When bees were confined," says M. Huber, "for the purpose of discovering whether honey was sufficient for the production of wax, they supported their captivity patiently, and showed uncommon perseverance in rebuilding their combs as we removed them. Our experiments required the presence of grubs; honey and water had to be provided; the bees were to be supplied with combs containing brood, and at the same time it was necessary to confine them, that they might not seek pollen abroad. Having a swarm by chance, which had become useless from the sterility of the queen, we devoted it for our investigation in one of my leaf hives, which was glazed on both sides. We removed the queen, and substituted combs containing eggs and young grubs, but no cell with farina; even the smallest particle of the substance which John Hunter conjectured to be the basis of the nutriment of the young was taken away. Nothing remarkable occurred during the first and second day: the bees brooded over the young, and seemed to take an interest in them; but at sunset, on the third, a loud noise was heard in the hive. Impatient to discover the reason, we opened a shutter, and saw all in confusion; the brood was abandoned; the workers ran in disorder over the combs; thousands rushed towards the lower part of the hive; and those about the entrance gnawed at its grating. Their design was not equivocal; they wished to quit their prison. Some imperious necessity evidently obliged them to seek elsewhere what they could not find in the hive; and apprehensive that they might perish if I restrained them longer from yielding to their instinct, I set them at liberty. The whole swarm escaped; but the hour being unfavourable for their collections, they flew around the hive, and did not depart from it. Increasing darkness and the coolness of the air compelled them very soon to return. Probably these circumstances calmed their agitation; for we observed them peaceably remounting their combs; order seemed re-established, and we took advantage of this moment to close the hive. Next day, the 19th of July, we saw the rudiments of two royal cells, which the bees had formed on one of the brood combs. This evening, at the same hour as on the preceding, we again heard a loud buzzing in the closed hive; agitation and disorder rose to the highest degree, and we were again obliged to let the swarm escape. The bees did not remain long absent from their habitation; they quieted and returned as before. We remarked on the 20th, that the royal cells had not been continued, as would have been the case in the ordinary state of things. A great tumult took place in the evening; the bees appeared to be in a delirium; we set them at liberty, and order was restored on their return. Their captivity having endured five days, we thought it needless to protract it farther; besides, we were desirous of knowing, whether the brood was in a suitable condition, and if it had made the usual progress; and we wished also to try to discover what might be the cause of the periodical agitation of the bees. M. Burnens (the assistant of Huber) having exposed the two brood combs, the royal cells were immediately recognized; but it was obvious that they had not been enlarged. Why should they? Neither eggs, grubs, nor that kind of paste peculiar to the individuals of their species, were there! The other cells were vacant likewise; no brood, not an atom of paste was in them. Thus the worms had died of hunger. Had we precluded the bees from all means of sustenance by removing the farina? To decide this point, it was necessary to confide other broods to the care of the same insects, now giving them abundance of pollen. They had not been enabled to make any collections while we examined their combs. On this occasion they escaped in an apartment where the windows were shut; and after substituting young worms for those they had allowed to perish, we returned them to their prison. Next day we remarked that they had resumed courage; they had consolidated the combs, and remained on the brood. They were then provided with fragments of combs, where other workers had stored up farina; and to be able to observe what they did with it, we took this substance from some of their cells, and spread it on the board of the hive. The bees soon discovered both the farina in the combs and what we had exposed to them. They crowded to the cells, and also descending to the bottom of the hives, took the pollen grain by grain in their teeth, and conveyed it to their mouths. Those that had eaten it most greedily, mounted the combs before the rest, and stopping on the cells of the young worms, inserted their heads, and remained there for a certain time. M. Burnens opened one of the divisions of the

venom-bag, and the sting. The honey-bag is as transparent as crystal, containing the honey that the bee has brushed from the flowers; of which the greater part is carried to the hive, and poured into the cells of the honey-comb, while the remainder serves for the bee's own nourishment; for, during summer, it never touches what has been laid up for winter. The sting which serves to defend this little animal from its enemies, is composed of three parts; the sheath and two darts, which are extremely small and penetrating. Both the darts have several small points or barbs, like those of a fish-hook, which render the sting more painful, and make the darts rankle in the wound. Still, however, this instrument would be very slight, did not the bee poison the wound. The sheath, which has a sharp point, makes the first impression; which is followed by that of the darts, and then the venomous liquor is poured in. The sheath sometimes sticks so fast in the wound, that the animal is obliged to leave it behind; by which the bee soon after dies, and the wound is considerably inflamed. It might at first appear well for mankind, if the bee were without its sting; but upon recollection, it will be found, that the little animal would then have too many rivals in sharing its labours. A hundred other lazy animals, fond of honey, and hating labour, would intrude upon the sweets of the hive; and the treasure would be carried off for want of armed guardians to protect it.

From examining the bee singly, we now come to consider it in society, as an animal not only subject to laws, but active, vigilant, laborious, and disinterested. All its provisions are laid up for the community; and all its arts in building a cell, designed for the benefit of posterity. The substance with which bees build their cells, is wax; which is fashioned into convenient apartments for themselves and their young. When they begin to work in their hives, they divide themselves into four companies: one of which roves in the fields in search of materials; another employs itself in laying out the bottom and partitions of their cells; a third is employed in making the inside smooth from the corners and angles; and the fourth company bring food for the rest, or relieve those who return with their respective burdens. But they are not kept constant to one employment; they often change the tasks assigned them: those that have been at work, being permitted to go abroad; and those that have been in the fields already, take their places. They seem even to have signs, by which they understand each other; for when any of them wants food, it bends down its trunk to the bee from whom it is expected, which then opens its honey-bag, and lets some drops fall into the other's mouth, which is at that time open to receive it. Their diligence and labour is so great, that in a day's time they are able to make cells, that lie upon each other, numerous enough to contain three thousand bees.

If we examine their cells, they will be found formed in the exactest proportion. It was said by Pappus, an ancient geometrician, that of all other figures, hexagons were the most convenient; for when placed touching each other, the most convenient room would be given, and the smallest lost. The cells of the bees are perfect hexagons: these, in every honey-comb, are double, opening on either side, and closed at the bottom. The bottoms



Part of Honey-comb with Queen's cell.

are composed of little triangular panes, which, when united together, terminate in a point, and lie exactly upon the extremities of other panes of the same shape, in opposite cells. These lodgings have spaces, like streets, between them, large enough to give the bees a free passage in and out; and yet narrow enough to preserve the necessary heat. The mouth of every cell is defended by a border, which makes the door a little less than the inside of a cell, which serves to strengthen the

hive gently, and powdered the workers, for the purpose of recognizing them when they should ascend the combs. He observed them during several hours, and by this means ascertained that they took so great a quantity of pollen only to impart it to their young. Then withdrawing the portions of comb which had been placed by us on the board of the hive, we saw that the pollen had been sensibly diminished in quantity. They were returned to the bees, to augment their provision still farther, for the purpose of extending the experiment. The royal, as well as several common cells were soon closed; and, on opening the hive, all the worms were found to have prospered. Some still had their food before them; the cells of others that had spun were shut with a waxen covering. We witnessed these facts repeatedly, and always with equal interest. They so decisively prove the regard of the bees towards the grubs which they are entrusted with rearing, that we shall not seek for any other explanation of their conduct. Another fact, no less extraordinary, and much more difficult to be accounted for, was exhibited by bees constrained to work in wax, several times successively, from the syrup of sugar. Towards the close of the experiment they ceased to feed the young, though in the beginning these had received the usual attention. They even frequently dragged them from their cells, and carried them out of the hive."

whole. These cells serve for different purposes; for laying up their young; for their wax, which in winter becomes a part of their food; and for their honey, which makes their principal subsistence.

It is well known that the habitation of bees ought to be very close; and what their hives want, from the negligence or unskilfulness of man, these animals supply by their own industry: so that it is their principal care, when first hived, to stop up all the crannies. For this purpose they make use of a resinous gum, which is more tenacious than wax, and differs greatly from it. This the ancients called *propolis*: it will grow considerably hard in June; though it will in some measure soften by heat; and is often found different in consistence, colour, and smell. It has generally an agreeable aromatic odour when it is warmed; and by some it is considered as a most grateful perfume. When the bees begin to work with it, it is soft, but it acquires a firmer consistence every day; till at length it assumes a brown colour, and becomes much harder than wax. The bees carry it on their hinder legs; and some think it is met with on the birch, the willow, and poplar. However it is procured, it is certain that they plaster the inside of their hives with this composition.

If examined through a glass hive, from the hurry the whole swarm is in, the whole appears at first like anarchy and confusion; but the spectator soon finds every animal diligently employed, and following one pursuit, with a settled purpose. Their teeth are the instruments by which they model and fashion their various buildings, and give them such symmetry and perfection. They begin at the top of the hive; and several of them work at a time at the cells which have two faces. If they are stinted with regard to time, they give the new cells but half the depth which they ought to have; leaving them imperfect, till they have sketched out the number of cells necessary for the present occasion. The construction of their combs costs them a great deal of labour: they are made by insensible additions; and not cast at once in a mould, as some are apt to imagine. There seems no end of their shaping, finishing, and turning them neatly up. The cells for their young are most carefully formed; those designed for lodging the drones, are larger than the rest; and that for the queen-bee the largest of all. The cells in which the young brood are lodged, serve at different times for containing honey; and this proceeds from an obvious cause: every worm, before it is transformed into an aurelia, hangs its old skin on the partitions of its cell; and thus, while it strengthens the wall, diminishes the capacity of its late apartment. The same cell, in a single summer, is often tenanted by three or four worms in succession; and the next season by three or four more. Each worm takes particular care to fortify the pannels of its cell, by hanging up its spoils there: thus, the partitions being lined six or eight deep, become at last too narrow for a new brood, and are converted into store-houses for honey.

Those cells where nothing but honey is deposited, are much deeper than the rest. When the harvest of honey is so plentiful that they have not sufficient room for it, they either lengthen their combs, or build more; which are much longer than the former. Sometimes they work at three combs at a time; for when there are three work-houses, more bees may be thus employed, without embarrassing each other.

But honey, as was before observed, is not the only food upon which these animals subsist. The meal of flowers, of which their wax is formed, is one of their most favourite repasts. This is a diet which they live upon during the summer; and of which they lay up a large winter provision. The wax of which their combs are made, is no more than this meal digested, and wrought into a paste. When the flowers upon which bees generally feed, are not fully blown, and this meal or dust is not offered in sufficient quantities, the bees pinch the tops of the stamina in which it is contained, with their teeth; and thus anticipate the progress of vegetation. In April and May, the bees are busy, from morning to evening, in gathering this meal; but when the weather becomes too hot in the midst of summer, they work only in the morning.

The bee is furnished with a stomach for its wax, as well as its honey. In the former of the two, their powder is altered, digested, and concocted into real wax, and is thus ejected by the same passage by which it was swallowed. Every comb, newly made, is white: but it becomes yellow as it grows old, and almost black when kept too long in the hive. Beside the wax thus digested, there is a large portion of the powder kneaded up for food in every hive, and kept in separate cells, for winter provision. This is called by the country people, bee-bread; and contributes to the health and strength of the animal during winter. Those who rear bees, may rob them of their honey, and feed them, during the winter, with treacle; but no proper substitute has yet been found for the bee-bread; and, without it, the animals become consumptive, and die.

As for the honey, it is extracted from that part of the flower called the nectareum. From the mouth this delicious fluid passes into the gullet; and then into the first stomach, or honey-bag, which, when filled, appears like

an oblong bladder. Children that live in country places, are well acquainted with this bladder; and destroy many bees, to come at their store of honey. When a bee has sufficiently filled its first stomach, it returns back to the hive, where it disgorges the honey into one of the cells. It often happens that the bee delivers its store to some other, at the mouth of the hive, and flies off for a fresh supply. Some honeycombs are always left open for common use; but many others are stopped up, till there is a necessity of opening them. Each of these is covered carefully with wax; so close, that the covers seem to be made at the very instant the fluid is deposited within them.

Having thus given a cursory description of the insect, individually considered, and of the habitation it forms, we next come to its social habits and institutions: and, in considering this little animal attentively, after the necessary precautions for the immediate preservation of the community, its second care is turned to the continuance of posterity. How numerous soever the multitude of bees may appear in one swarm, yet they all owe their original to a single parent, which is called the *Queen-Bee*. It is indeed surprising that a single insect shall, in one summer, give birth to above twenty thousand young: but, upon opening her body the wonder will cease; as the number of eggs appearing at one time, amounts to five thousand.[1] This animal, whose existence is of so much importance to her subjects, may easily be distinguished from the rest by her size, and the shape of her body. On her safety depends the whole welfare of the commonwealth; and the attentions paid her by all the rest of the swarm, evidently show the dependence her subjects have upon her security. If this insect be carefully observed,

[1] *On the conversion of the larva of a Worker into a Queen.*—Bees, when deprived of their queen, are endowed by nature with the power of remedying this calamity, by converting a worker larva into a royal one; and, by means of a cell of a larger size, and of a peculiar kind of nourishment, of producing a female that shall be, to all intents and purposes, a queen or mother-bee, capable of perpetuating her kind. The discovery of this singular fact is generally attributed to Schirach, and, probably, with justice; for, although the practice of making artificial swarms, which can only be effected by causing the production of artificial queens, is said to have pervailed amongst the modern Greeks and Italians from a very early period, it does not follow, nor does it appear from any authentic documents, that they were aware of the reason why. The manner in which Schirach made the discovery is interesting:—Having used a great quantity of smoke in some of his operations, the bees were so annoyed by it that numbers of them left the hive, and, amongst them, the queen. Knowing the consequences of her loss, he sought for her diligently, but in vain. Next morning he observed a cluster of bees about the size of an apple on the prop of the hive whose queen had fled; here he discovered a queen, and, having carried her to the entrance of the hive which had lost its own, she was immediately surrounded by the bees, and treated in such a manner as plainly announced that she was their queen. "What was my astonishment," he proceeds, "when, wishing to introduce her among the combs, I saw that the bees remaining had already planned and almost finished three royal cells! Struck with the activity and sagacity of these creatures, to save themselves from impending destruction, I was filled with admiration, and adored the infinite goodness of God in the care taken to perpetuate his works. Having carried away two of the cells to ascertain whether the bees would continue their operations, I beheld, next morning, with the utmost surprise, that they had removed all the food from around the third worm left behind, on purpose to prevent its conversion to a queen." The fact of this power possessed by the bees is so extraordinary, that its reality was at first called in question by several eminent naturalists, among others, by the justly celebrated Bonnet. This naturalist was at last, however, convinced of its reality by experiments instituted by himself, and, satisfied that all the working-bees are females of imperfect organisation, expressed his opinion that the evolution of the germ is effected by the action of the prolific matter as a stimulant, as a substantial nutriment suitable for that purpose; and he supposes that a certain quality of food administered more copiously than in ordinary cases, may unfold those organs in the larvæ of bees that never would have appeared without it. He conceived, also, that a habitation, like a queen-cell, considerably more spacious, and differently placed, is absolutely necessary to the complete development of organs, which the new nutriment may cause to grow in all directions. It furnishes a surprising evidence of the slow degrees by which scientific facts make their way, if not essential to general utility, when we consider that to this day, the knowledge of this singularity in the natural history of this insect, is confined almost exclusively to apiarians, and even rejected by some of them. It has, however, been confirmed by so many experiments instituted by many different individuals, that no unprejudiced mind can withhold its assent from its truth.

The proceedings of the bees, in order to supply the loss of their queen, are extremely interesting. In about twenty-four hours they are aware of the misfortune that has befallen them, and, without loss of time, they set about repairing the disaster. They fix upon a worm not more than three days old, demolish the three contiguous cells, and raise around it a regular cylindrical inclosure. At the end of three days, the workers change the direction of the cell, which has hitherto been horizontal, into a perpendicular position, working downwards till it assume the appearance of a stalactite. In due time it is sealed, and the larva undergoes its metamorphosis into a royal nymph. Huber gives a detail of some interesting experiments on this head, the substance only of which we can present to our readers. He deprived a hive of its queen, and put into it some pieces of comb containing worker eggs. The same day several cells were enlarged by the bees, and converted into royal cells, and the larvæ supplied with a profusion of jelly. He then removed these worms from the royal cells, and substituted for them as many common worms from workers' cells. The bees did not seem aware of the change, they watched over the new worms as intently as over those chosen by themselves; they continued enlarging the cells, and closed them at the usual time. At the proper time, two queens were hatched, almost at the same moment, of the largest size, and well formed in every respect. Nothing could be more conclusive than this experiment. It demonstrated that bees have the power of converting the worms of workers into queens, since they succeeded in procuring them by operating on worms not chosen by themselves, but selected for them.—*Naturalist's Library. Edin.* 1840.

she will be seen at times attended with a numerous retinue, marching from cell to cell, plunging the extremity of her body into many of them, and leaving a small egg in each.

The bees which generally compose her train are thought to be males, which serve to impregnate her by turns. These are larger and blacker than the common bees; without stings, and without industry. They seem formed only to transmit a posterity; and to attend the queen, whenever she thinks proper to issue from the secret retreats of the hive, where she most usually resides. Upon the union of these two kinds depends all expectations of a future progeny; for the working bees are of no sex, and only labour for another offspring: yet such is their attention to the queen, that if she happens to die, they will leave off working, and take no further care of posterity. If, however, another queen is, in this state of universal despair, presented them, they immediately acknowledge her for their sovereign, and once more diligently apply to their labour. It must be observed, however, that all this fertility of the queen-bee, and the great attentions paid to her by the rest, are controverted by more recent observers. They assert, that the common bees are parents themselves; that they deposit their eggs in the cells which they have prepared; that the females are impregnated by the males, and bring forth a progeny, which is wholly their own.[1]

However, to go on with their history, as delivered us by Mr Reaumur.—When the queen-bee has deposited the number of eggs necessary in the cells, the working bees undertake the care of the rising posterity. They are seen to leave off their usual employments; to construct proper receptacles for eggs; or to complete those that are already formed. They purposely build little cells, extremely solid, for the young; in which they employ a great deal of wax: those designed for lodging the males, as was already observed, are larger than the rest; and those for the queen-bees the largest of all. There is usually but one egg deposited in every cell; but when the fecundity of the queen is such, that it exceeds the number of cells already prepared, there are sometimes three or four eggs crowded together in the same apartment. But this is an inconvenience that the working bees will by no means suffer. They seem sensible that two young ones, stuffed up in the same cell, when they grow larger, will but embarrass and at last destroy each other: they therefore take care to leave a cell to every egg; and remove or destroy the rest.

The single egg that is left remaining, is fixed to the bottom of the cell, and touches it but in a single point. A day or two after it is deposited, the worm is excluded from the shell of the egg, having the appearance of a maggot rolled up in a ring, and lying softly on a bed of a whitish-coloured jelly; upon which also the little animal begins to feed. In the meantime, the instant it appears, the working bees attend it with the most anxious and parental tenderness; they furnish it every hour with a supply of this whitish substance, on which it feeds and lies; and watch the cell with unremitting care. They are nurses that have a greater affection for the offspring of others, than many parents have for their own children. They are constant in visiting each cell, and seeing that nothing is wanting; preparing the white mixture, which is nothing but a composition of honey and wax, in their own bowels, with which they feed them. Thus attended, and plentifully fed, the worm, in less than six days' time, comes to its full growth, and no longer accepts the food offered it. When the bees perceive that it has no further occasion for feeding, they perform the last offices of tenderness, and shut the little animal up in its cell; walling up the mouth of its apartment with wax: where they leave the worm to itself; having secured it from every external injury.

The worm is no sooner left inclosed, but from a state of inaction, it begins to labour, extending and shortening its body; and by this means lining the walls of its apartment with a silken tapestry, which it spins in the manner of caterpillars, before they undergo their last transformation. When their cell is thus prepared, the animal is soon after transformed into an aurelia; but differing from that of the common caterpillar, as it exhibits not only the legs, but the wings of the future bee, in its present state of inactivity. Thus, in about twenty or one and twenty days after the egg was laid, the bee is completely formed, and fitted to undergo the fatigues of its state. When all its parts have acquired their proper strength and consistence, the young animal opens its prison, by piercing with its teeth the waxen door that confines it. When just freed from its cell, it is as yet moist, and incommoded with the spoils of its former situation: but the officious bees are soon seen to flock round it, and to lick it clean on all sides with their trunks; while another band, with equal assiduity, are observed to feed it with honey: others again begin immediately to cleanse the cell that has been just left; to carry the ordure out of the hive, and to fit the place for a new inhabitant. The young bee soon repays their care by its industry; for as soon as ever its external parts become dry, it discovers its natural appetites for labour, and industriously begins the task, which it pursues unremittingly

[1] See Note at the beginning of the chapter.

through life. The toil of man is irksome to him, and he earns his subsistence with pain ; but this little animal seems happy in its pursuits, and finds delight in all its employments.

When just freed from the cell, and properly equipped by its fellow-bees for duty, it at once issues from the hive, and instructed only by Nature, goes in quest of flowers, chooses only those that yield it a supply, rejects such as are barren of honey, or have been already drained by other adventurers ; and when loaded, is never at a loss to find its way back to the common habitation. After this first sally, it begins to gather the mealy powder that lies on every flower, which is afterwards converted into wax ; and with this, the very first day, it returns with two large balls stuck to its thighs.

When bees first begin to break their prisons, there are generally above a hundred excluded in one day. Thus, in the space of a few weeks, the number of the inhabitants in one hive, of moderate size, becomes so great, that there is no place to contain the new comers ; and they are scarcely excluded from the cell, when they are obliged, by the old bees, to sally forth in quest of new habitations. In other words, the hive begins to swarm, and the new progeny prepares for exile.[1]

While there is room enough in the hive, the bees remain quietly together ; it is necessity alone that compels the separation. Sometimes, indeed, the young brood, with grace-

[1] Those not experienced in the nature of bees, may be greatly deceived in the purchasing of hives for stock. It can only be by a minute examination of the interior of the hive, that a just estimate of its value may be gained ; this, however, is attended with much difficulty, and some danger ; but by the outward appearance and weight of the hive he may perhaps arrive at nearly a correct conjecture. The best season for purchasing is either in February or at the swarming season ; in February it has survived the rigour of winter, and the purchaser has then only to attend to the population of the hive, or its apparent age. Let the purchaser observe with attention the number of bees which enter the hive loaded with the fruits of their industry ; and if an apparently equal number departs in great bustle and hurry, he may then conjecture the hive to be in good health and well populated ; and if a loud humming noise is heard within the hive, it is a certain sign of its strength and prosperity. The weight of a hive in February should never be under fifteen pounds, nor in autumn under thirty ; and care should be taken that the hive is new, for in old hives a quantity of farina or bee-head accumulates, which adds considerably to its weight ; the purchaser should also reject a hive when he observes its straw decayed and rotten, the ligaments loose, and frequent blotches over it, for it will cost him incessant trouble and vexation to keep it in a sufficient state of preservation, so as to maintain the health of his bees.

The apiary, or place where the bee-hives are placed, should in very warm situations be made to face the east, and in colder districts the south-east. It should be well protected from high winds, which not only prevent the bees from leaving the hive in quest of honey, but they also surprise them in the fields, and often kill them by dashing them against the trees and rocks or into rivers. The hives in an apiary should always be placed in a right line ; but should the number of the hives be great, and the situation not capacious enough to admit of their being placed longitudinally it is more advisable to place them over one another on shelves than in double rows on the ground. A bee, on leaving the hive, generally forms an angle of about forty-five with the horizon ; the elevation of the hive should therefore be about two feet from the ground, in order to protect it from humidity. The greater the elevation of the hive, the longer is the flight of the swarm ; and when they are at a certain point of elevation, the swarms are lost for ever to the proprietor. If the hives are to be placed in a double row, the hinder ones should alternate with, and be placed at such a distance from, the front ones, that when the bees take their flight no obstruction is offered to their ascent. Huish recommends placing every hive upon a single pedestal, and at two or three feet distance from each other. By this means, when any thing happens to one hive, the others are less likely to be disturbed than when placed on a shelf in a bee-house ; and the hive may be chained down and locked. It is usual to have three or four legs or supports to the bee-boards ; but those who have tried one will never resort to more, as one is a much better protection from vermin and insects. The space in front of the apiary should be kept clear of high plants for two or three yards.

The variety of bees employed is a matter of some consequence. To the common observer all working bees, as to external appearance, are nearly the same ; but to those who examine them with attention, the difference in size is very distinguishable ; and they are, in their vicious and gentle, indolent and active natures, essentially different. Of the stock which Howison had in 1810, it required 250 to weigh an ounce ; but they were so vicious and lazy that he changed it for a smaller variety, which possessed much better dispositions, and of which it required 296, on an average, to weigh an ounce. Whether size and disposition are invariably connected, is not determined.

The best material and form for hives is a straw thimble or flower-pot placed in an inverted position. Hives made of straw, as now in use, have a great advantage over those made of wood and other materials, from the effectual defence they afford against the extremes of heat in summer and cold in winter.

The size of hives should correspond as nearly as possible with that of the swarms. This has not had that attention paid to it which the subject demands, as much of the success in the management of the bees depends on that circumstance. From blind instinct bees endeavour to fill with combs whatever hive they are put into, before they begin to gather honey. Owing to this, when the hive is too large for its inhabitants, the time for collecting their winter store is spent in unprofitable labour ; and starvation is the consequence. This evil also extends to occasioning late swarming the next summer ; it being long before the hive becomes so filled with young bees as to produce a necessity for emigration, from which cause the season is too far advanced for the young colonies to procure a winter stock. A full-sized straw hive will hold three pecks ; a small-sized from one and a half to two pecks.

The Polish hive appears to be the second in merit to that described, and perhaps it may deserve the preference, if the mode of using it were generally known. It is simply the trunk of a tree, of a foot or fourteen inches in diameter, and about nine feet long. It is scooped out (boring in this country would be better) for about six feet from one end, so as to form a hollow cylinder of that length, and of six or eight inches in diameter within. Part of the circumference of this cylinder is cut out during the greater part of its length, about four inches wide

less obstinacy, refuse to depart, and even venture to resist their progenitors. The young ones are known by being browner than the old, with whiter hair; the old ones are of a lighter colour, with red hair. The two armies are therefore easily distinguishable, and dreadful battles are often seen to ensue. But the victory almost ever terminates with strict political justice in favour of the veterans, and the rebellious offspring are driven off, not without loss and mutilation.

In different countries, the swarms make their appearance at different times of the year, and there are several signs previous to this intended migration. The night before, an unusual buzzing is heard in the hive; in the morning, though the weather be soft and inviting, they seem not to obey the call, being intent on more important meditations within. All labour is discontinued in the hive; every bee is either employed in forcing, or reluctantly yielding, a submission; at length, after some noise and tumult, a queen-bee is chosen to guard, rather than conduct the young colony to other habitations, and then they are marshalled without any apparent conductor. In less than a minute they leave their native abode, and forming a cloud round their protectress, they set off without seeming to know the place of their destination; *the world before them, where to choose their place of rest.* The usual time of swarming is from ten in the morning to three in the afternoon, when the sun shines bright, and invites them to seek their fortunes. They flutter for a while in the air, like flakes of snow, and sometimes undertake a distant journey, but more frequently are contented with some neighbouring asylum: the branch of a tree, a chimney-top, or some other exposed situation. It is, indeed, remarkable, that all those animals, of whatever kind, that have long been under the protection

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and a slip of wood is made to fit the opening. On the sides of this slip, or segment, notches are made every two or three inches, of sufficient size to allow a single bee to pass. This slip may be furnished with hinges, and with a lock and key; but in Poland it is merely fastened in by a wedge. All that is wanting to complete the hive is a cover at top to throw off the rain; and then it requires only to be placed upright like a strong post in the garden, so as the bottom of the hollow cylinder may be not nearer the ground than two feet, and the opening slip look to the south. When a swarm is to be put in, the tree, with the door or slip opened, is placed obliquely over it; when the bees enter, the door is closed, and the holes stopped with clay till the hive is planted or placed upright. When honey is wanted, the door is opened during the finest part of a warm day, when most of the bees are out; its entire state is seen from top to bottom, and the operator, with a segar in his mouth, or with a lighted rag, to keep off the bees from his hands, cuts out with a crooked knife as much comb as he thinks fit. In this way fresh honey is obtained during the summer, the bees are never cramped for room, nor does it become necessary to kill them. The old comb, however, is annually cut out, to prevent or lessen the tendency to swarming, which, notwithstanding this and the size of their dwelling, they generally do once a year; for the laws of nature are not to be changed. Though it be a fact that a small swarm of bees will not do well in a large hive; yet, if the hive extend in length and not in breadth, it is admitted both by Huber and Huish that they will thrive in it. "If too great a diameter," says Huber, "be not given to the abode of the bee, it may without danger be increased in the elevation; their success in the hollow trees, their natural domicile, incontestably proves the truth of this assertion."

The feeding of bees is generally deferred till winter or spring; but this is a most erroneous practice. Hives should be examined in the course of the month of September, or about the time of killing the drones; and if a large hive does not weigh thirty pounds, it will be necessary to allow it half a pound of honey, or the same quantity of soft sugar made into syrup, for every pound that it is deficient of that weight; and in like proportion to smaller hives. This work must not be delayed, that time may be given for the bees to make the deposit in their empty cells before they are rendered torpid by the cold. Sugar simply dissolved in water (which is a common practice), and sugar boiled with water into a syrup, form compounds very differently suited for the winter store of bees. When the former is wanted for their immediate nourishment, as in spring, it will answer equally as a syrup; but if to be laid up as store, the heat of the hive quickly evaporating the water, leaves the sugar in dry crystals, not to be acted upon by the trunks of the bees. Hives may be killed with hunger while some pounds' weight of sugar remain in this state in their cells. The boiling of sugar into syrup forms a closer combination with the water, by which it is prevented from flying off, and a consistence resembling that of honey retained. Howison had frequent experience of hives, not containing a pound of honey, preserved in perfect health through the winter with sugar so prepared, when given in proper time and in sufficient quantity. The quantity of food which ought to be given to a hive may be calculated in the proportion of two pounds a month; but if the weather be very cold, a less quantity will suffice. When a hive is fed in the spring, it should always be after sunset, when the bees have returned from the fields; otherwise the most disastrous consequences may ensue from the robberies committed by the bees of other hives. If they are fed in the morning, it must be before sunrise, and the entrance instantly stopped to keep out depredators; for as the bees leave the hive on the very first appearance of day-light, a later period would prevent the return of all those who had left the hive previous to the entrance being secured. The following receipt for bees is recommended as beneficial and economical. To two quarts of good ale put one pound of moist sugar; boil them until the sugar is wholly dissolved, carefully skimming it; when it is cold, it will be found of the consistency of honey, and it may be given to the bees in the following manner: If the bees are in the plain cottage hive, an eek of the same diameter as the hive must be provided, and from three to four hands in height. When the sun is set, and the bees have retired, let the hive be gently raised, and the eek placed on the stool: then, having filled a soup-plate with the food, place it on the eek, and put down the hive. To prevent the bees being drowned in the liquid, it is necessary to place some straws over the plate, and over the straws a piece of paper, either thickly perforated or cut into nicks; these nicks, however, must not run parallel with the straws, but either across or diagonally; the entrance must then be closed, and the plate removed on the following morning, and the whole of the liquid will be transferred into the combs.

of man, seem to lose a part of their natural sagacity in providing for themselves. The rabbit, when domesticated, forgets to dig holes, the hen to build a nest, and the bee to seek a shelter that shall protect it from the inclemencies of winter. In those countries where the bees are wild, and unprotected by man, they are always sure to build their waxen cells in the hollow of a tree; but with us, they seem improvident in their choice, and the first green branch that stops their flight, seems to be thought sufficient for their abode through winter. However, it does not appear that the queen chooses the place where they are to alight, for many of the stragglers, who seemed to be pleased with a particular branch, go and settle upon it; others are seen to succeed; and, at last, the queen herself, when she finds a sufficient number there before her, goes to make it the place of her head-quarters. When the queen is settled, the rest of the swarm soon follow; and, in about a quarter of an hour, the whole body seem to be at ease. It sometimes is found, that there are two or three queens to a swarm, and the colony is divided into parties; but it most usually happens, that one of these is more considerable than the others, and the bees, by degrees, desert the weakest, to take shelter under the most powerful protector. The deserted queen does not long survive this defeat; she takes refuge under the new monarch, and is soon destroyed by her jealous rival. Till this cruel execution is performed, the bees never go out to work; and if there should be a queen-bee belonging to the new colony left in the old hive, she always undergoes the fate of the former. However, it must be observed, that the bees never sacrifice any of their queens, when the hive is full of wax and honey; for there is at that time no danger in maintaining a plurality of breeders.

When the swarm is thus conducted to a place of rest, and the policy of government is settled, the bees soon resume their former labours. The making cells, storing them with honey, impregnating the queen, making proper cells for the reception of the rising progeny, and protecting them from external danger, employ their unceasing industry. But soon after, and towards the latter end of summer, when the colony is sufficiently stored with inhabitants, a most cruel policy ensues. The drone bees, which are (as has been said) generally in a hive to the number of a hundred, are marked for slaughter. These, which had hitherto led a life of indolence and pleasure, whose only employment was in impregnating the queen, and rioting upon the labours of the hive, without aiding in the general toil, now share the fate of most voluptuaries, and fall a sacrifice to the general resentment of society.

The working bees in a body declare war against them; and in two or three days' time the ground all round the hive is covered with their dead bodies. Nay, the working bees will even kill such drones, as are yet in the worm state, in the cell, and eject their bodies from the hive among the general carnage.

When a hive sends out several swarms in the year, the first is always the best, and the most numerous. These having the whole summer before them, have the more time for making wax and honey, and consequently their labours are the most valuable to the proprietor. Although the swarm chiefly consists of the youngest bees, yet it is often found that bees of all ages compose the multitude of emigrants, and it often happens that bees of all ages are seen remaining behind. The number of them is always more considerable than that of some populous cities, for sometimes upwards of forty thousand are found in a single hive. So large a body may well be supposed to work with great expedition; and in fact, in less than twenty-four hours they will make combs above twenty inches long, and seven or eight broad. Sometimes they will half fill their hives with wax in less than five days. In the first fifteen days, they are always found to make more wax than they do afterwards during the rest of the year.

Such are the outlines of the natural history of these animals, as usually found in our own country. How they are treated, so as to produce the greatest quantity of honey, belongs rather to the rural economist, than the natural historian; volumes have been written on the subject, and still more remains equally curious and new. One thing, however, it may be proper to observe, that a farm, or a country, may be over-stocked with bees, as well as with any other sort of animal; for a certain number of hives always require a certain number of flowers to subsist on. When the flowers near home are rifled, then are these industrious insects seen taking more extensive ranges: but their abilities may be over taxed; and if they are obliged, in quest of honey, to go too far from home, they are over-wearied in the pursuit, they are devoured by birds, or beat down by the winds and rain.

From a knowledge of this, in some parts of France and Piedmont, they have contrived, as I have often seen, a kind of floating bee-house.

They have on board one barge threescore or a hundred bee-hives, well defended from the inclemency of an accidental storm: and with these the owners suffer themselves to float gently down the river. As the bees are continually choosing their flowery pasture along the banks of the stream, they are furnished with sweets before unrifled; and thus

a single floating bee-house yields the proprietor a considerable income. Why a method similar to this has never been adopted in England, where we have more gentle rivers, and more flowery banks, than in any other part of the world, I know not: certainly it might be turned to advantage, and yield the possessor a secure, though perhaps a moderate income.

Having mentioned the industry of these admirable insects, it will be proper to say something of the effects of their labour of that wax and honey which are turned by man to such various uses. Bees gather two kinds of wax; one coarse, and the other fine. The coarser sort is bitter, and with this, which is called *propolis*, they stop up all the holes and crevices of their hives.[1] It is of a more resinous nature than the fine wax, and is consequently better qualified to resist the moisture of the season, and preserve the works warm and dry within. The fine wax is as necessary to the

[1] It was strongly suspected by Reaumur, that the bees collected the propolis from those trees which are known to produce a similar gummy resin, such as the poplar, the birch, and the willow; but he was thrown into doubt by not being able to detect the bees in the act of procuring it, and by observing them to collect it where none of those trees, nor any other of the same description, grew. His bees also refused to make use of bitumen, and other resinous substances, with which he supplied them, though Mr Knight was more successful.

Huber at length set the question at rest. "For many years," says he, "I had fruitlessly endeavoured to find them on trees producing an analogous substance, though multitudes had been seen returning laden with it. In July, some branches of the wild poplar, which had been cut since spring, with very large buds, full of a reddish, viscous, odoriferous matter, were brought to me, and I planted them in vessels before hives, in the way of the bees going out to forage, so that they could not be insensible of their presence. Within a quarter of an hour they were visited by a bee, which separating the sheath of a bud with its teeth, drew out threads of the viscous substance, and lodged a pellet of it in one of the baskets of its limbs: from another bud it collected another pellet for the opposite limb, and departed to the hive. A second bee took the place of the former in a few minutes, following the same procedure. Young shoots of poplar, recently cut, did not seem to attract these insects, as their viscous matter had less consistence than the former. Different experiments proved the identity of this substance with propolis; and now, having only to discover how the bees applied it to use, we peopled a hive, so prepared as to fulfil our views. The bees, building upwards, soon reached the glass above; but, unable to quit their habitation, on account of rain, they were three weeks without bringing home propolis. Their combs remained perfectly white until the beginning of July, when the state of the atmosphere became more favourable for our observations. Serene warm weather engaged them to forage, and they returned from the fields laden with a resinous gum, resembling a transparent jelly, and having the colour and lustre of the garnet. It was easily distinguished from the farinaceous pellets then collected by other bees. The workers bearing the propolis ran over the clusters suspended from the roof of the hive, and rested on the rods supporting the combs, or sometimes stopped on the sides of their dwelling, in expectation of their companions coming to discumber them of their burden. We actually saw two or three arrive, and carry the propolis from off the limbs of each with their teeth. The upper part of the hive exhibited the most animated spectacle: thither a multitude of bees resorted from all quarters, to engage in the predominant occupation of the collection, distribution, and application of the propolis. Some conveyed that of which they had unloaded the purveyors in their teeth, and deposited it in heaps; others hastened, before its hardening, to spread it out like a varnish, or form it into strings, proportioned to the interstices of the sides of the hive to be filled up. Nothing could be more diversified than the operations carried on.

The bees, apparently charged with applying the propolis within the cells, were easily distinguished from the multitude of workers, by the direction of their heads towards the horizontal pane forming the roof of the hive, and on reaching it, they deposited their burden nearly in the middle of intervals separating the combs: then they conveyed the propolis to the real place of its destination. They suspended themselves by the claws of the hind legs to points of support, afforded by the viscosity of the propolis on the glass; and, as it were, swinging themselves backwards and forwards, brought the heap of this substance nearer to the cells at each impulse. Here the bees employed their fore feet, which remained free, to sweep what the teeth had detached, and to unite the fragments scattered over the glass, which recovered all its transparency when the whole propolis was brought to the vicinity of the cells. After some of the bees had smoothed down and cleaned out the glazed cells, feeling the way with their antennæ, one desisted, and having approached a heap of propolis, drew out a thread with its teeth. This being broken off, it was taken in the claws of the fore feet, and the bee, re-entering the cell, immediately placed it in the angle of two portions that had been smoothed, in which operation the fore feet and teeth were used alternately; but probably proving too clumsy, the thread was reduced and polished; and we admired the accuracy with which it was adjusted when the work was completed. The insect did not stop here: returning to the cell, it prepared other parts of it to receive a second thread, for which we did not doubt that the heap would be resorted to. Contrary to our expectation, however, it availed itself of the portion of the thread cut off on the former occasion, arranged it in the appointed place, and gave it all the solidity and finish of which it was susceptible. Other bees concluded the work which the first had begun; and the sides of the cells were speedily secured with threads of propolis, while some were also put on the orifices; but we could not seize the moment when they were varnished, though it may be easily conceived how it is done."

This is not the only use to which bees apply the propolis. They are extremely solicitous to remove such insects or foreign bodies as happen to get admission into the hive. When so light as not to exceed their powers, they first kill the insect with their stings, and then drag it out with their teeth. But it sometimes happens, as was first observed by Maraldi, and since by Reaumur and others, that an ill-fated snail creeps into the hive: this is no sooner perceived than it is attacked on all sides, and stung to death. But how are the bees to carry out so heavy a burthen? Such a labour would be in vain. To prevent the noxious smell which would arise, from its putrefaction, they immediately embalm it, by covering every part of its body with propolis, through which no effluvia can escape. When a snail with a shell gets entrance, to dispose of it gives much less trouble and expense to the bees. As soon as it receives the first wound from a sting, it naturally retires within its shell. In this case, the bees, instead of pasting it all over with propolis, content themselves with gluing all round the margin of the shell, which is sufficient to render the animal for ever immovably fixed.

animal's preservation as the honey itself. With this they make their lodgings, with this they cover the cells of their young, and in this they lay up their magazines of honey. This is made, as has been already observed, from the dust of flowers, which is carefully kneaded by the little insect, then swallowed, and having undergone a kind of digestion, is formed into the cells, which answer such a variety of purposes. To collect this, the animal rolls itself in the flower it would rob, and thus takes up the vegetable dust with the hair of its body. Then carefully brushing it into a lump, with its fore-paws it thrusts the composition into two cavities behind the thighs, which are made like spoons to receive the wax, and the hair that lines them serves to keep it from falling.

As of wax, there are also two kinds of honey; the white and the yellow. The white is taken without fire from the honey-combs. The yellow is extracted by heat, and squeezed through bags, in a press. The best honey is new, thick, and granulated, of a clear transparent white colour, of a soft and aromatic smell, and of a sweet lively taste. Honey made in mountainous countries is preferable to that of the valley. The honey made in the spring is more highly esteemed than that of autumn, when the flowers begin to fade, and lose their fragrance.

The bees are nearly alike in all parts of the world; yet there are differences worthy our notice. In Guadaloupe, the bee is less by one half than the European, and more black and round. They have no sting, and make their cells in hollow trees; where, if the hole they meet with is too large, they form a sort of waxen house of the shape of a pear, and in this they lodge and store their honey, and lay their eggs. They lay up their honey in waxen vessels, of the size of a pigeon's egg, of a black or deep violet colour; and these are so joined together, that there is no space left between them. The honey never congeals, but is fluid, of the consistence of oil, and the colour of amber. Resembling these, there are found little black bees, without a sting, in all the tropical climates; and though these countries are replete with bees like our own, yet those form the most useful and laborious tribe in that part of the world. The honey they produce is neither so unpalatable nor so surfeiting as ours; and the wax is so soft that it is only used for medicinal purposes, it being never found hard enough to form into candles, as in Europe.

Of insects that receive the name of bees among us, there are several; which, however, differ very widely from that industrious social race we have been just describing. The Humble-bee is the largest of all this tribe, being as large as the first joint of one's middle finger.[1] These are seen in every field, and

Mr Knight, President of the Horticultural Society, discovered by accident an artificial substance, more attractive than any of the resins experimentally tried by Reaumur. Having caused the decorticated part of a tree to be covered with a cement, composed of bees'-wax and turpentine, he observed that this was frequented by hive-bees, who, finding it to be a very good propolis ready made, detached it from the tree by their mandibles, and then, as usual, passed it from the first leg to the second, and so on. When one bee had thus collected its load, another often came behind and despoiled it of all it had collected; a second and a third load were frequently lost in the same manner; and yet the patient insect pursued its operations without manifesting any signs of anger. Probably the latter circumstance, at which Mr Knight seems to have been surprised, was nothing more than an instance of the division of labour so strikingly exemplified in every part of the economy of bees.

[1] The humble-bees of this country are now divided into two generic groups, *Bombus* and *Apathus*. They may be distinguished from the hive-bee, and other races bearing affinity to them, by having the simple eyes arranged in a curve, instead of forming a triangle; by having an impression in the shape of a cross on the forehead; the labrum transverse, and two distinct spines at the apex of the posterior tibiæ. More obvious characters are afforded by their large, comparatively rounded, hirsute bodies, generally adorned with bands of light-yellow or red. Upwards of forty different species are described as inhabitants of Britain; but as the three distinct races of females, males, and workers, belonging to the same species, often bear little resemblance to one another, and as the hair or down covering their bodies, often of the gayest colours, changes with age, like the plumage of birds, it is by no means unlikely that individuals of the same family, and differing only in sex or age, have in some instances, been described as of a different species.

The common humble-bee abounds in our fields and gardens, and is almost equally common throughout all



Europe. It is distinguished above its congeners for strength and activity. It is one of the earliest insects that appear in the spring, and one of the latest to leave us in autumn. It forms its nest, as is well known, in holes in the ground, sometimes excavated laboriously by its own efforts, sometimes previously formed by other animals and taken possession of by the foundress of the colony. The females of this, as of all the other species, are largest in size, the males next, and the workers smallest. Early in spring, when the willows begin to bloom, the female may be seen traversing the gardens by sun-rise with her usual sonorous booming, and busied in collecting honey and pollen from the catkins. The workers do not appear till a somewhat later period, and the males not till autumn, when the thistles are in blossom, upon the flowers of which they are found in great numbers, and in still greater, if possible, upon seeding

perched on every flower. They build their nest in holes in the ground, of dry leaves, mixed with wax and wood, defended with moss from the weather. Each humble-bee makes a separate cell about the size of a small nutmeg, which is round and hollow, containing the honey in a bag. Several of these cells are joined together in such a manner, that the whole appears like a cluster of grapes. The females, which have the appearance of wasps, are very few, and their eggs are laid in cells, which the rest soon cover over with wax. It is uncertain whether they have a queen or not; but there is one much larger than the rest, without wings, and without hair, and all over black, like polished ebony. This goes and views all the works, from time to time, and enters into the cell, as if it wanted to see whether every thing was done right. In the morning the young humble-bees are very idle, and seem not at all inclined to labour, till one of the largest, about seven o'clock, thrusts half its body from a hole designed for that purpose, and seated on the top of the nest, beats its wings for twenty minutes successively, buzzing the whole time, till the whole colony is put in motion. The humble-bees gather honey as well as the common bees; but it is neither so fine nor so good, nor the wax so clean, or so capable of fusion.

Beside the bees already mentioned, there are various kinds among us, that have much the appearance of honey-makers, and yet make only wax. The Wood-Bee is seen in every garden. It is rather larger than the common queen-bee; its body of a bluish black, which is smooth and shining. It begins to appear at the approach of spring, and is seen flying near walls exposed to a sunny aspect. This bee makes its nest in some piece of wood, which it contrives to scoop and hollow for its purpose.[1] This, however, is never done in

leeks and onions, where, on a single flower, may be seen half a dozen at the same moment. At this early period of the year, the female is a solitary being, and her flights are directed in search of a place suitable for a habitation. The females only, of all the former year's colony, have survived the winter, and now dispersing, each seeks a residence for herself, where she may become the foundress of a new community. Having pitched upon a convenient spot, the laborious insect proceeds to excavate first the passage or gallery, then the nest itself, detaching the soil, as it were, grain by grain; she seizes the molecule with the first pair of legs, transfers it instantly to the second, receives it next with the third, and finally pushes it as far as possible behind her. These excavations, situated often above a foot under the surface, are wholly the work of the solitary female. Sometimes, however, the nest is made close to, or even upon the surface when partially hollow, and covered with dry moss; but this is not the usual mode pursued by this species, and in such localities the colony is far less numerous than when at a greater depth.

Having finished the excavation, and carpeted her new dwelling with soft leaves, &c., the insect proceeds to construct brood cells. The wax of which these are formed is secreted, as in the domestic bee, in certain receptacles placed on each side of the middle process of the abdominal scales, and is extracted by the bee in the form of laminæ, moulded to the shape of the insect's body. Unlike the queen of the hive bees, the mother-bee of this family possesses these wax-secreting organs as well as the workers, and produces the substance in greater quantity than her progeny.

[1] We have frequently witnessed, says Mr Rennie, the operations of these ingenious little workers, who are particularly partial to posts, palings, and the wood-work of houses which has become soft by beginning to decay. Wood actually decayed, or affected by dry-rot, they seem to reject as unfit for their purposes; but they make no objections to any hole previously drilled, provided it be not too large; and, like the mason-bees, they not unfrequently take possession of an old nest, a few repairs being all that in this case is necessary. When a new nest is to be constructed, the bee proceeds to chisel sufficient space for it out of the wood with her jaws. We say *her*, because the task in this instance, as in most others of solitary bees and wasps, devolves solely upon the female, the male taking no concern in the affair, and probably being altogether ignorant that such a work is going forward. It is at least certain the male is never seen giving his assistance, and he seldom if ever approaches the neighbourhood. The female carpenter-bee has a task to perform no less arduous than the mason-bee; for though the wood may be tolerably soft, she can only cut out a very small portion at a time. The successive portions which she gnaws off may be readily ascertained by an observer, as she carries them away from the place. In giving the history of a mason-wasp, we remarked the care with which she carried to a distance little fragments of brick, which she detached in the progress of excavation. We have recently watched a precisely similar procedure in the instance of a *carpenter-bee* forming a cell in a



wooden post. The only difference was, that the bee did not fly so far away with her fragments of wood as the wasp did; but she varied the direction of her flight every time; and we could observe, that after dropping the chip of wood which she had carried off, she did not return in a direct line to her nest, but made a circuit of some extent before wheeling round to go back.

"On observing the proceedings of this carpenter-bee next day, we found her coming in with balls of pollen on her thighs; and on tracing her from the nest into the adjacent garden, we saw her visiting every flower which was likely to yield her a supply of pollen for her future progeny. This was not all: we subsequently saw her taking the direction of a clay-quarry frequented by the mason-bees, where we recognized her loading herself with a pellet of clay, and carrying it into her cell in the wooden post. We observed her alternating this labour for several days, at one time carrying clay, and at another pollen; till at length she completed her task, and closed the entrance with a barricado of clay, to prevent the intrusion of any insectivorous depredator, who might make prey of her young; or of some prying parasite, who might introduce its own eggs into the nest she had taken so much trouble to construct.

trees that are standing, for the wood it makes choice of is half rotten. The holes are not made directly forward, but turning to one side, and have an opening sufficient to admit one's middle finger, from whence runs the inner apartment, generally twelve or fifteen inches long. The instruments used in boring these cavities are their teeth; the cavity is usually branched into three or four apartments; and in each of these they lay their eggs, to the number of ten or twelve, each separate and distinct from the rest: the egg is involved in a sort of paste, which serves at once for the young animal's protection and nourishment. The grown bees, however, feed upon small insects, particularly a louse, of a reddish brown colour, of the size of a small pin's head.

Mason-Bees make their cells with a sort of mortar made of earth, which they build against a wall that is exposed to the sun. The mortar, which at first is soft, soon becomes as hard as stone, and in this their eggs are laid. Each nest contains seven or eight cells, an egg in every cell, placed regularly one over the other. If the nests remain unhurt, or want but little repairs, they make use of them the year ensuing; and thus they often serve three or four years successively. From the strength of their houses, one would think these bees in perfect security; yet none are more exposed than they. A worm with very strong teeth is often found to bore into their little fortifications, and devour their young.

The Ground-Bee builds its nest in the earth,

"Some days after it was finished, we cut into the post, and exposed this nest to view. It consisted of six cells of a somewhat square shape, the wood forming the literal walls; and each was separated from the one adjacent by a partition of clay, of the thickness of a playing card. The wood was not lined with any extraneous substance, but was worked as smooth as if it had been chiselled by a joiner. There were five cells, arranged in a very singular manner—two being almost horizontal, two perpendicular, and one oblique. The depth to which the wood was excavated, in this instance, was considerably less than what we have observed in other species which dig perpendicular galleries several inches deep in posts and garden-seats; and they are inferior in ingenuity to the carpentry of a bee described by Reaumur, which has not been ascertained to be a native of Britain, though a single indigenous species of the genus has been doubtingly mentioned, and is figured by Kirby, in his valuable 'Monographia.' If it ever be found here, its large size and beautiful violet-coloured wings will render mistakes impossible.

"The violet carpenter-bee usually selects an upright piece of wood, into which she bores obliquely for about an inch; and then, changing the direction, works perpendicularly, and parallel to the sides of the wood, for twelve or fifteen inches, and half an inch in breadth. Sometimes the bee is contented with one or two of these excavations; at other times, when the wood is adapted to it, she scoops out three or four—a task which sometimes requires several weeks of incessant labour. The tunnel in the wood, however, is only one part of the work; for the little architect has afterwards to divide the whole into cells, somewhat less than an inch in depth. It is necessary, for the proper growth of her progeny, that each should be separated from the other, and be provided with adequate food. She knows, most exactly, the quantity of food which each grub will require, during its growth; and she therefore does not hesitate to cut it off from any additional supply. In constructing her cells, she does not employ clay, like the bee which we have mentioned above, but the sawdust, if we may call it so, which she has collected in gnawing out the gallery. It would not, therefore, have suited her design to scatter this about, as our carpenter-bee did. The violet bee, on the contrary, collects her gnawings into a little store-heap for future use, at a short distance from her nest. She proceeds thus:—At the bottom of her excavation she deposits an egg, and over it fills a space nearly an inch high with the pollen of flowers, made into a paste with honey. She then covers this over with a ceiling composed of cemented sawdust, which also serves for the floor of the next chamber above it. For this purpose, she cements round the wall a ring of wood chips, taken from her store-heap; and within this ring forms another, gradually contracting the diameter till she has constructed a circular plate, about the thickness of a crown-piece, and of considerable hardness. This plate of course exhibits concentric circles, somewhat similar to the annual circles in the cross section of a tree. In the same manner she proceeds till she has completed ten or twelve cells; and then she closes the main entrance with a barrier of similar materials.

"Let us compare the progress of this little joiner with a human artisan—one who has been long practised in his trade, and has the most perfect and complicated tools for his assistance. The bee has learned nothing by practice; she makes her nest but once in her life, but it is then as complete and finished as if she had made a thousand. She has no pattern before her—but the Architect of all things has impressed a plan upon her own mind, which she can realize without scale or compasses. Her two sharp teeth are the only tools with which she is provided for her laborious work; and yet she bores a tunnel, twelve times the length of her own body, with greater ease than the workman who bores into the earth for water, with his apparatus of augers adapted to every soil. Her tunnel is clean and regular; she leaves no chips at the bottom, for she is provident of her materials. Further, she has an exquisite piece of joinery to perform, when her ruder labour is accomplished. The patient bee works her rings from the circumference to the centre, and she produces a shelf, united with such care with her natural glue, that a number of fragments are as solid as one piece.

"The violet carpenter-bee, as may be expected, occupies several weeks in these complicated labours; and during that period she is gradually depositing her eggs, each of which is successively to become a grub, a pupa, and a perfect bee. It is obvious, therefore, as she does not lay all her eggs in the same place—as each is separated from the other by a laborious process—that the egg which is first laid will be the earliest hatched; and that the first perfect insect, being older than its fellows in the same tunnel, will strive to make its escape sooner, and so on of the rest. The careful mother provides for this contingency. She makes a lateral opening at the bottom of the cells; for the teeth of the young bees would not be strong enough to pierce the outer wood, though they can remove the cemented rings of saw-dust in the interior. Reaumur observed these holes, in several cases; and he further noticed another external opening opposite to the middle cell, which he supposed was formed, in the first instance, to shorten the distance for the removal of the fragments of wood in the lower half of the building."—*Insect Architecture.*

wherein it makes round holes, five or six inches deep; the mouth being narrow, and only just sufficient to admit the little inhabitant.

It is amusing enough to observe the patience and assiduity with which they labour. They carry out all the earth, grain by grain, to the mouth of the hole, where it forms a little hillock; an Alps, compared to the power of the artist by which it is raised. Sometimes the walks of a garden are found undermined by their labours: some of the holes running directly downward, others horizontally beneath the surface. They lay up in these cavities provisions for their young, which consist of a paste that has the appearance of corn, and is of a sweetish taste.

The Leaf-cutting Bees make their nest and



lay their eggs among bits of leaves, very artificially placed in holes in the earth, of about the length of a tooth-pick case. They make the bits of leaves of a roundish form, and with them line the inside of their habitations. This tapestry is still further lined by a reddish kind of paste, somewhat sweet or acid. These bees are of various kinds; those that build their nests with chestnut leaves are as big as drones, but those of the rose-tree are smaller than the common bee.[1]

The Wall-Bees are so called because they make their nests in walls, of a kind of silky membrane with which they fill up the vacuities between the small stones which form the sides of their habitation. Their apartment consists of several cells placed end to end, each in the shape of a woman's thimble. Though the web which lines this habitation is thick and warm, yet it is transparent, and of a whitish colour. This substance is supposed to be spun from the animal's body. The males and females are of a size, but the former are without a sting.—To these varieties of the bee kind might be added several others, which are all different in their nature, but not sufficiently distinguished to excite curiosity.[2]

[1] A species of the leaf-cutting or upholsterer bee is called the *poppy-bee*, from its selecting the scarlet petals of the poppy as tapestry for its cells. Kirby and Spence express their doubts whether it is indigenous to this country: but Mr Rennie is almost certain that he saw the nests in Scotland. The poppy-bee may be known by its being rather more than a third of an inch long, of a black colour, studded on the head and back with reddish gray hairs; the belly being gray and silky, and the rings margined with gray above, the second and third having an impressed transversal line.

[2] The Rev. Mr Kirby has discovered that there are no less than *two hundred and twenty-one* distinct species of bees. He divides the Linnæan genus into *mellitta* and *apis*, distinguishing them by their tongues; the insects of the first having short flattish inflected tongues.

We shall here merely specify the *Carding-Bee*, as one of peculiar interest, and no ways uncommon about our villages. This bee is yellow, with the hair of the throat somewhat fawn-coloured. The carding-bees nearly all perish in winter; a few of the females only survive. These usually make their appearance early in spring, as soon as the catkins of the willows are in blossom; upon which, at this time, they may commonly be seen collecting honey from the female, and pollen from the male catkins. The neuters do not appear till the spring is somewhat advanced, and the males are most common in autumn, when the thistles are in blossom, upon the flowers of which they are abundant, sometimes appearing to be asleep or torpid, and at other times acting as if they were intoxicated with the sweets they have been imbibing. When these insects of any sex are walking on the ground, if a finger be moved to them, they lift up three legs on one side, by way of defence, which give them a very grotesque appearance. Their nests are usually formed in meadows and pastures, sometimes in groves and hedge-rows, where the soil is entangled with roots; but now and then these are found in heaps of stones. When they do not meet with an accidental cavity ready made, they excavate one themselves with great labour. This they cover with a thick convex vault of moss, sometimes casting the interior surface with a kind of coarse wax, to keep out the wet. At the lower part of the nest there is an opening for the inhabitants to go in and out at. This entrance is often through a long gallery or covered way, a foot or upwards in length, by which the nest is more effectually concealed from observation. The mode in which they transport the moss which they employ in the formation of their nest is singular. When they have discovered a parcel fitted to that purpose, and conveniently situated, they place themselves in a line, with their backs turned towards the nest. The foremost lays hold of some with their jaws, and clears it, bit by bit, with her fore-feet. When this is sufficiently disentangled, she drives it with her feet under her belly, and as far as possible beyond, to the second bee. The second, in like manner, pushes it on to the third, and so on. Thus small heaps of prepared moss are conveyed to the nest by a file of four or five insects, where they are wrought with the greatest dexterity by those that remain within. The nests are often six or seven inches in diameter, and elevated to the height of four or five inches above the surface of the ground.

[3] The Wasps (*Vespa*), like the ants and bees, live in society. They are comparable to the latter for their in-

CHAP. III.

OF THE WASP.

However similar many insects may be in appearance, this does not imply a similitude in their history. The bee and the wasp resemble each other very strongly, yet, in examining their manner and their duration, they differ very widely: the bee labours to lay up honey, and lives to enjoy the fruits of its industry: the wasp appears equally assiduous: but only works for posterity, as the habitation is scarcely completed when the inhabitant dies.

The wasp[3] is well known to be a winged

insect with a sting;—to be longer in proportion to its bulk than the bee, to be marked with bright yellow circles round its body, and to be the most swift and active insect of all the fly kind. On each side of the mouth this animal is furnished with a long tooth, notched like a saw, and with these it is enabled to cut any substance, not omitting meat itself, and

dustry, and approximate to the former in the extent of their ravages. The bee, continually occupied with its labours, lives only on what it gathers from flowers, and the sting with which it is armed, is merely a defensive weapon, never unsheathed but for the protection of itself or its country. But the wasp, on the contrary, is ferocious, and subsists only on rapine and destruction. Its sting is an offensive weapon, a means of overpowering animals more feeble than itself. Nevertheless it is not less ingenious than the others, nor less attached to its offspring. United in a single republic, the wasps spare neither care nor labour. The works which they perform evince their dexterity, their patience, and the delicacy of their instinct. The peculiar style of their architecture is worthy of admiration.

Among them we particularly distinguish two species, the *hornet* (*vespa crabro*), and the *common wasp* (*vulgaris*). The first makes its nests sheltered from winds and heavy rains, either in barns or the holes of old walls, but most frequently in the large trunks of trees, the interior of which is rotten. There these insects form a large cavity, by detaching fragments of the wood, which is ready to fall into dust. It is in spring that the females, after having passed the winter in a lethargic state, and now reanimated by the heat of the atmosphere, issue from their retreat, to find out a suitable place in which to establish their nest. This place once found, they lay there the first foundations of the edifice, which consist of a thick and solid pillar of the same material as the rest of the nest, but much harder, and more compact. The material of which the wasps makes use, is the bark of the slender branches of the ash, which they detach in filaments. Then they grind and bruise it with their mandibles, so as to form a paste, which hardens after it has been employed in building. They collect, at the same time, a clear and saccharine fluid, which drops from the places which have been recently gnawed from the branch which they have been despoiling. This pillar is always placed in the most elevated part of the vault, and the hornets attach to it a sort of cap or covering of the same material, which is to serve as a roof to the edifice, and prevent the dirt, &c., detached from the upper part of the ground cavity, from falling on the combs. Within this cavity or vault they place a second pillar, which is in some sort only a continuation of the first. This is to serve for a base to the first comb of the cells. These cells are hexagonal, and their aperture is turned downwards. The mother constructs some of them. As none but females are found in spring, it is probable that they have been fecundated previously to the winter. What is certain is, that the females commence laying as soon as they have constructed a few cells in which to deposit their eggs. These eggs soon disclose the young, and the mother feeds the young larvæ which issue from them, with the products of the chase. When the latter have acquired their full growth, they line their cells with silk, and stop them with a covercle of the same material. Beneath this envelope they undergo their metamorphoses. They do not come forth from it until they are perfect insects. The wasps which are first born are workers. Analogy leads us to the belief that, as among the *bees*, they are only females destitute of the ovariæ. They are designed for the occupation of constructing the nest, and nursing the larvæ. As the female continues to lay, the family increases, and the lodging becomes too small. Then the workers increase the covering and the comb, and when the latter is pushed to the edge of this envelope, they construct another immediately. This last is attached to the first by one or many pillars. Speedily the covering is finished, and filled with new combs. Then there remains but a single aperture to the nest. This aperture corresponds to that of the hole which is the gate through which the wasps arrive at their nest. It is often no more than an inch in diameter.

It is only towards the commencement of autumn that the young females and young males come forth from their nymph state. All the larvæ which could not become perfect insects until the month of October, usually are put to death before this period, especially when the cold begins to be sensibly perceptible. The wasps, instead of continuing to nourish the larvæ, are then solely occupied in plucking them out of their cells, and flinging them out of the nest. The nymphs, or pupæ, meet with no more mercy. The males and workers are daily perishing, from the growing inclemency of the season; so that at the end of the winter, none but some females remain, which have passed that season in a state of lethargy, at the bottom of the nest.

In autumn, males and females are to be met with on trees, from which acid and saccharine fluids exude. They return no more to the nest, and perish miserably on the first approach of cold. Thus invariably finishes this society, whose largest population but little exceeds one hundred, or one hundred and fifty individuals.

The *common wasp* makes its nest in the ground, usually at the depth of about half a foot. The entrance to it is a conduit of about an inch in diameter, and very seldom in a straight line. The edges which are at the surface of the earth look as if they were ploughed.

The most usual form of the vespiary is that of a ball. It is thirteen or fourteen inches in diameter: its envelope is a sort of paper or paste-board, which is sometimes more than an inch in thickness. Its colour is a gray of different shades, disposed in bands. This envelope is rough, and appears formed of pieces, in the form of valves of shells placed one upon the other, so that nothing is seen but their convex exterior. When finished, this envelope has two gates, which are two round holes, through which the wasps enter and go out. The interior of the nest is occupied by several combs, parallel, and pretty nearly horizontal: they resemble those of the bees in form, but are composed of a very different material. The vespiary sometimes contains fifteen or sixteen combs of a diameter proportioned to that of the envelope. All these combs are, as it were, so many floors, disposed in stories, which furnish the means of lodging a great number of inhabitants. Free passages are left between them. In these intervals are sorts of columns, which serve to support the combs. The foundations of the edifice, (if we may use such a solecism) are, at its highest part, for the wasps, unlike other builders, begin their work at the top, and descend as they go on with it: these pillars, formed of the same material as the combs and envelope, are massive; their base and capital are of greater diameter than the rest.

These wasps, which work under ground, are concealed from our inspection; they must therefore be drawn, that we may observe the manner in which they construct their nest. When a nest is procured, which is easily done, there is no fear that they will abandon it. It may then be placed under a glass hive, where we can have the pleasure of seeing these insects at their work.

As soon as they are lodged, they begin by repairing the disorders which the vespiary may have suffered, after having attached it solidly to the hive, and they increase the thickness of its envelope.

This envelope deserves a description a little more detailed. Its thickness, which is often more than an inch,

to carry it to its nest. Wasps live, like bees, in community, and sometimes ten or twelve thousand are found inhabiting a single nest.

Of all other insects the wasp is the most fierce, voracious, and most dangerous, when enraged. They are seen wherever flesh is cutting up, gorging themselves with the spoil, and then flying to their nests with their reeking prey. They make war also on every other fly, and the spider himself dreads their approaches.

Every community among bees is composed of females, or queens, drones or males, and neutral or working bees. Wasps have similar

is not massive. It is formed of several layers, which have vacancies between them: each layer is as thin as a sheet of paper. In proportion as the wasps thicken this envelope, they build another layer on those which are already formed. The number of these layers sometimes exceeds fifteen or sixteen.

Nothing can be more amusing than to see these wasps working for the purpose of extending or thickening this envelope. Several of them are engaged at this work, which they perform with the greatest celerity, and without the least confusion. They proceed into the country to find the necessary materials: she that has collected some, returns loaded with a little ball composed of a soft paste; she holds it between her jaws. Arrived at the vespiary, she takes it to the place where she intends to labour, and immediately applies it there. She walks backwards; at each step which she makes, she leaves before her a portion of the ball, without detaching it from the rest, which she holds between her two fore feet. When she has thus applied it all, she unites and smooths it, by repassing over it several times. The materials which she employs are filaments of wood, which she tears off with her mandibles: she moistens and kneads them well previously to use.

These vespiaries contain males, females, and workers: these last, as among the bees and other social insects, are charged with all the labours of the society. Those that go in search of provision are continually employed in the chase; some seize on insects by main force, which they bring back almost entire to the nest; others pillage the shops of butchers, where each one attaches herself to the piece of meat which she prefers, and when she is satiated, cuts off a piece, sometimes larger than herself, to carry it home. Others again plunder the fruits of gardens and orchards: they gnaw or suck them, and bring back the juice. All share their spoils with the males and females, and even with the other workers; and the division is made with the most perfect good will on all sides.

The mothers do not fly into the country, excepting in spring and autumn. During the summer, they are shut up in the interior of the vespiary, occupied in laying, and especially in nursing their larvæ.

A vespiary which has all its combs usually contains fifteen or sixteen thousand cells, each of which is filled by an egg or a nymph. It is the larvæ principally that occupy the attention of the wasps. The latter feed them in the same manner in which birds feed their young, giving them from time to time the *bill-full*, after having softened in their mouth the aliments which the larvæ could not otherwise digest.

Twenty days having elapsed since the eggs were laid, the larvæ are now ready to be metamorphosed into nymphs. Like those of the hornet, they inclose themselves in their cells, and become perfect insects eight or nine days after they have been changed into nymphs. The cell which a young wasp has quitted does not remain a long time vacant. An old wasp cleans it out and renders it fit for the reception of a new egg.

The cells destined for the eggs which produce the workers are never placed among those which contain the eggs destined to give birth to males and females. The edifice built by the wasps, and which occupies them during some months, is to last no longer than a year. This habitation, so populous during summer, is almost deserted in the winter, and entirely abandoned in the spring: most of its inhabitants have perished the preceding autumn. Some females destined to perpetuate the species pass the winter in a state of numbness, and in the following spring each of them becomes the foundress of a new republic, and the mother of all the individuals which compose it. The workers, as being the most useful, are the first who are born: the males and females do not appear until towards the end of summer, or the commencement of autumn: they couple in the vespiary itself in which they were born.

The occupation of the males in the vespiary is limited to cleaning it out and removing the dead bodies: they are smaller than the females, and larger than the workers, which are the smallest of the three kinds of individuals which compose the society. Like the males of the bees, they are destitute of a sting. The mothers and the workers are alone provided with this organ. The sting of the females is longer than that of the workers, and the wound which the wasps inflict is more severe, and causes a sharper pain than that made by the bees. The violent smarting which it produces is, however, caused in the same manner, by a poisonous fluid, which is introduced into the wound.

Peace does not always reign in the societies of the wasps. Combats often take place among the workers, or between them and the males. The last individuals are more cowardly or weaker than the others; but these combats are rarely fatal.

When the cold weather first approaches, the workers snatch from their cells the larvæ which are not yet metamorphosed, and assisted by the males, turn them neck and heels out of the nest. It appears that they know that the little ones could not support cold and hunger during the winter season, when at this early period they can scarcely find wherewithal to nourish them. To cause them thus to perish is, therefore, an act of mercy, not of cruelty. It is the quick prevention of a long and lingering state of misery.

Notwithstanding all the admirable industry of the wasps, agriculturists are not the less desirous to get rid of these insects, which do most particular damage to fruits, even previously to their maturity. Many means have been pointed out for destroying the species which live in a social state, especially the common wasp. When the places which they inhabit can be discovered, it is easy to dispatch thousands of them in a little time. Some have adopted the plan of putting glue on blades of straw, and placing them in the neighbourhood of the nest, but this method is long and troublesome. Boiling water cast into the hole may be used with success. But when the nests are remote from houses, a sufficient quantity cannot well be obtained to destroy the wasps: sulphur matches are far more efficacious. The aperture of the hole which conducts to the vespiary must be widened a little, and lighted matches introduced into the hole, after which its entrance must be closed with small stones, so that the wasps cannot get out without mining, which they cannot do in a little time: they will then assuredly be suffocated by the vapour of the sulphur. Care must be taken, however, not to close the hole so exactly as to prevent all access of air, and give no issue to the smoke, for then the matches would be too soon extinguished.—*Supplement to the English edition of the Animal Kingdom, by Baron Cuvier.*

occupations; the two first are for propagating the species, the last for nursing, defending, and supporting the rising progeny. Among bees, however, there is seldom above a queen or two in a hive; among wasps there are above two or three hundred.

As soon as the summer begins to invigorate the insect tribes, the wasps are the most of the number, and diligently employed either in providing provisions for their nest, if already made; or in making one, if the former habitation be too small to receive the increasing community. The nest is one of the most curious objects in natural history, and contrived almost as artificially as that of the bees themselves. Their principal care is to seek out a hole that has been begun by some other animal, a field-mouse, a rat, or a mole, to build their nests in. They sometimes build upon the plain, where they are sure of the dryness of their situation; but most commonly on the side of a bank, to avoid the rain or water that would otherwise annoy them. When they have chosen a proper place, they go to work with wonderful assiduity. Their first labour is to enlarge and widen the hole, taking away the earth, and carrying it off to some distance. They are perfectly formed for labour, being furnished with a trunk above their mouths, two saws on each side, which play to the right and left against each other, and six strong muscular legs to support them. They cut the earth into small parcels with their saws, and carry it out with their legs or paws. This is the work of some days; and at length the outline of their habitation is formed, making a cavity of about a foot and a half every way. While some are working in this manner, others are roving the fields to seek out materials for their building. To prevent the earth from falling down and crushing their rising city into ruin, they make a sort of roof with their gluey substance, to which they begin to fix the rudiments of their building, working from the top downwards, as if they were hanging a bell; which, however, at length they close up at the bottom. The materials with which they build their nests are bits of wood and glue. The wood they get where they can from the rails and posts which they meet with in the fields and elsewhere. These they saw and divide into a multitude of small fibres, of which they take up little bundles in their claws, letting fall upon them a few drops of gluey matter, with which their bodies are provided, by the help of which they knead the whole composition into a paste, which serves them in their future building. When they have returned with this to the nest, they stick their load of paste on that part where they make their walls and partitions; they tread it close with their feet, and trowl it with their trunks, still going backwards as they work. Having repeated this operation three or four times, the composition is at length flatted out until it becomes a small leaf of a gray colour, much finer than paper, and of a pretty firm texture. This done, the same wasp returns to the field to collect a second load of paste, repeating the same several times, placing layer upon layer, and strengthening every partition in proportion to the wants or convenience of the general fabric. Other working wasps come quickly after to repeat the same operation, laying more leaves upon the former, till at length, after much toil, they have finished the large roof, which is to secure them from the tumbling in of the earth. This dome being finished, they make another entrance to their habitation, designed either for letting in the warmth of the sun, or for escaping, in case one door be invaded by plunderers. Certain however, it is, that by one of these they always enter, by the other they sally forth to their toil; each hole being so small that they can pass but one at a time. The walls being thus composed, and the whole somewhat of the shape of a pear, they labour at their cells, which they compose of the same paper-like substance that goes to the formation of the outside works. Their combs differ from those of bees not less in the composition than the position which they are always seen to obtain. The honey-comb of the bee is edge-ways with respect to the hive; that of the wasp is flat, and the mouth of every cell opens downwards. Thus is their habitation contrived, story above story, supported by several rows of pillars, which give firmness to the whole building, while the upper story is flat-roofed, and as smooth as the pavement of a room, laid with squares of marble. The wasps can freely walk upon these stories between the pillars to do whatever their wants require. The pillars are very hard and compact, being larger at each end than in the middle, not much unlike the columns of a building. All the cells of the nest are only destined for the reception of the young, being replete with neither wax nor honey.

Each cell is like that of the bee, hexagonal: but they are of two sorts; the one larger, for the production of the male and female wasps; the other less, for the reception of the working part of the community. When the females are impregnated by the males, they lay their eggs, one in each cell, and stick it in with a kind of gummy matter to prevent its falling out. From this egg proceeds the insect in its worm state, of which the old ones are extremely careful, feeding it from time to time till it becomes large, and entirely fills up its cell. But the wasp community differs from that of

the bee in this; that among the latter the working bees take the parential duties upon them, whereas among the wasps the females alone are permitted to feed their young, and to nurse their rising progeny. For this purpose the female waits with great patience till the working-wasps have brought in their provisions, which she takes from them, and cuts into pieces. She then goes with great composure from cell to cell, and feeds every young one with her mouth. When the young worms have come to a certain size they leave off eating, and begin to spin a very fine silk, fixing their first end to the entrance of the cell: then turning their heads, first on one side, then on the other, they fix the thread to different parts, and thus they make a sort of door, which serves to close up the mouth of the cell. After this they divest themselves of their skins after the usual mode of transformation; the aurelia, by degrees, begins to emancipate itself from its shell; by little and little it thrusts out its legs and wings, and insensibly acquires the colour and shape of its parent.

The wasp thus formed, and prepared for depredation, becomes a bold, troublesome, and dangerous insect: there are no dangers which it will not encounter in pursuit of its prey, and nothing seems to satiate its gluttony. Though it can gather no honey of its own, no animal is more fond of sweets. For this purpose it will pursue the bee and the humble-bee, destroy them with its sting, and then plunder them of their honey-bag, with which it flies triumphantly loaded to its nest to regale its young. Wasps are ever fond of making their nests in the neighbourhood of bees, merely to have an opportunity of robbing their hives, and feasting on the spoil. Yet the bees are not found always patiently submissive to their tyranny, but fierce battles are sometimes seen to ensue, in which the bees make up by conduct and numbers what they want in personal prowess. When there is no honey to be had, they seek for the best and sweetest fruits, and they are never mistaken in their choice. From the garden they fly to the city, to the grocer's shops, and butcher's shambles. They will sometimes carry off bits of flesh half as big as themselves, with which they fly to their nests for the nourishment of their brood. Those who cannot drive them away, lay for them a piece of ox's liver, which being without fibres, they prefer to other flesh; and whenever they are found, all other flies are seen to desert the place immediately. Such is the dread with which these little animals impress all the rest of the insect tribes, which they seize and devour without mercy, that they vanish at their approach. Wherever they fly, like the eagle or the falcon, they form a desert in the air round them. In this manner the summer is passed in plundering the neighbourhood, and rearing up their young: every day adds to their numbers; and from their strength, agility, and indiscriminate appetite for every kind of provision, were they as long-lived as the bee, they would soon swarm upon the face of nature, and become the most noxious plague of man; but providentially their lives are measured to their mischief, and they live but a single season.

While the summer heats continue, they are bold, voracious, and enterprising; but as the sun withdraws, it seems to rob them of their courage and activity. In proportion as the cold increases, they are seen to become more domestic; they seldom leave the nest; they make but short adventures from home, they flutter about in the noon-day heats, and soon after return chilled and feeble.

As their calamities increase, new passions soon begin to take place; the care for posterity no longer continues; and as the parents are no longer able to provide their growing progeny a supply, they take the barbarous resolution of sacrificing them all to the necessity of the times. In this manner, like a garrison upon short allowance, all the useless hands are destroyed; the young worms, which a little before they fed and protected with so much assiduity, are now butchered, and dragged from their cells. As the cold increases, they no longer find sufficient warmth in their nests, which grow hateful to them, and they fly to seek it in the corners of houses, and places that receive an artificial heat. But the winter is still insupportable; and before the new year begins, they wither and die; the working-wasps first, the males soon following, and many of the females suffer in the general calamity. In every nest, however, one or two females survive the winter, and having been impregnated by the male during the preceding season, she begins in spring to lay her eggs in a little hole of her own contrivance. This bundle of eggs, which is clustered together like grapes, soon produces two worms, which the female takes proper precaution to defend and supply, and these, when hatched, soon give assistance to the female, who is employed in hatching two more; these also gathering strength, extricate themselves out of the web that enclosed them, and become likewise assistants to their mother; fifteen days after, two more make their appearance; thus is the community every day increasing, while the female lays in every cell, first a male and then a female. These soon after become breeders in turn, till from a single female, ten thousand wasps are seen produced before the month of June. After the female has thus produced her progeny, which are distributed in different districts, they assemble from all parts in

the middle of summer, and provide for themselves the large and commodious habitation which has been described above.[1]

Such is the history of the social wasp; but, as among bees, so also among these insects, there are various tribes that live in solitude; these lay their eggs in a hole for the purpose, and the parent dies long before the birth of its offspring. In the principal species of the Solitary-Wasps, the insect is smaller than the working-wasp of the social kind. The filament by which the corselet is joined to the body, is longer and more distinctly seen, and the whole colour of the insect is blacker than in the ordinary kinds. But it is not their figure, but the manners of this extraordinary insect, that claim our principal regard.

From the end of May to the beginning of July, this wasp is seen most diligently employed. The whole purpose of its life seems to be in contriving and fitting up a commodious apartment for its young one, which is not to succeed it till the year ensuing. For this end it is employed, with unwearied assiduity, in boring a hole in the finest earth some inches deep, but not much wider than the diameter of its own body. This is but a gallery leading to a wider apartment destined for the convenient lodgment of its young. As it always chooses a gravelly soil to work in, and where the earth is almost as hard as stone itself, the digging and hollowing this apartment is an enterprise of no small labour: for effecting its operations, this insect is furnished with two teeth, which are strong and firm, but not sufficiently hard to penetrate the substance through which it is resolved to make its way. In order therefore to soften that earth which it is unable to pierce, it is furnished with a gummy liquor, which it emits upon the place, and which renders it more easily separable from the rest, and the whole becoming a kind of soft paste, is removed to the mouth of the habitation. The animal's provision of liquor in these operations is, however, soon exhausted; and it is then seen taking up water either from some neighbouring flower or stream, in order to supply the deficiency.

At length, after much toil, a hole some inches deep is formed, at the bottom of which is a large cavity; and to this no other hostile insect would venture to find its way, from the length and the narrowness of the defile through which it would be obliged to pass. In this the solitary wasp lays its egg, which is destined to continue the species; there the nascent animal is to continue for about nine months, unattended and immured, and at first appearance the most helpless insect of the creation. But when we come to examine, new wonders offer; no other insect can boast so copiously luxurious a provision, or such confirmed security.

As soon as the mother wasp has deposited her egg at the bottom of the hole, her next care is to furnish it with a supply of provisions, which may be offered to the young insect as soon as it leaves the egg. To this end she procures a number of little green worms, generally from eight to twelve, and these are to serve as food for the young one the instant it awakens into life. When this supply is regularly arranged and laid in, the old one then, with as much assiduity as it before worked out its hole, now closes the mouth of the passage; and thus leaving its young one immured in perfect security, and in a copious supply of animal food, she dies, satisfied with having provided for a future progeny.

When the young one leaves the egg, it is scarcely visible, and is seen immured among a number of insects, infinitely larger than itself, ranged in proper order around it, which, however, give it no manner of apprehension. Whether the parent, when she laid in the insect provision, contrived to disable the worms from resistance, or whether they were at first incapable of any, is not known. Certain it is, that the young glutton feasts upon the living spoil without any control: his game lies at his hand, and he devours one after the other as the calls of appetite incite him. The life of the young animal is therefore spent in the most luxurious manner, till its whole stock of worms is exhausted, when the time of its transforma-

[1] "One of the most remarkable of our native social wasps is the *Vespa Britannica*, or tree-wasp, which is not uncommon in the northern, but seldom to be met with in the southern parts of the island. Instead of burrowing in the ground like the common wasp, or in the hollows of trees like the hornet, it boldly swings its nest from the extremity of a branch, where it exhibits some resemblance, in size and colour, to a Welsh wig, hung out to dry. We have seen more than one of these nests on the same tree, at Catrine, in Ayrshire, and at Wemyss Bay, in Renfrewshire. The tree which the Britannic wasp prefers is the silver fir, whose broad flat branch serves as a protection to the suspended nest both from the sun and the rain.

"Reaumur has given a very interesting account of the wasps of Cayenne, which hang their nests on trees. Like the bird of Africa called the Loxia, they fabricate a perfect house, capable of containing many hundreds of their community, and suspend it on high out of the reach of attack. But the Cayenne wasp is a more expert artist than the bird. He is a card-maker;—and travellers of veracity agree that the card with which he forms the exterior covering of his abode is so smooth, so strong, so uniform in its texture, and so white, that the most skilful manufacturer of this substance might be proud of the work.

"The nest of the card-making wasp is impervious to water. It hangs upon the branch of a tree; and those rain-drops which penetrate through the leaves never rest upon its hard and polished surface. A small opening for the entrance of the insects terminates its funnel-shaped bottom. It is impossible to unite more perfectly the qualities of lightness and strength."—*Insect Architecture.*

tion begins to approach; and then spinning a silken web, it continues fixed in its cell till the sun calls it from its dark abode the ensuing summer.

The wasps of Europe are very mischievous, yet they are innocence itself when compared to those of the tropical climates, where all the insect tribes are not only numerous but large, voracious, and formidable. Those of the West Indies are thicker, and twice as long, as the common bee; they are of a gray colour, striped with yellow, and armed with a very dangerous sting. They make their cells in the manner of a honey-comb, in which the young ones are hatched and bred. They generally hang their nests by threads, composed of the same substance with the cells, to the branches of trees, and the eaves of houses. They are seen every where in great abundance, descending like fruit, particularly pears, of which shape they are, and as large as one's head. The inside is divided into three round stories full of cells, each hexagonal, like those of a honey-comb. In some of the islands these insects are so very numerous, that their nests are stuck up in this manner, scarce two feet asunder, and the inhabitants are in continual apprehension from their accidental resentment. It sometimes happens that no precautions can prevent their attacks, and the pain of their sting is almost insupportable. Those who have felt it, think it more terrible than even that of a scorpion; the whole visage swells, and the features are so disfigured, that a person is scarcely known by his most intimate acquaintance.

CHAP. IV.

OF THE ICHNEUMON FLY.

Every rank of insects, how voracious soever, have enemies that are terrible to them, and that revenge upon them the injuries done upon the rest of the animated creation. The wasp as we have seen, is very troublesome to man, and very formidable to the insect tribe; but the ichneumon fly (of which there are many varieties) fears not the wasp itself; it enters its retreats, plunders its habitations, and takes possession of that cell for its own young, which the wasp had laboriously built for a dearer posterity.

Though there are many different kinds of this insect, yet the most formidable, and that best known, is called the common ichneumon, with four wings, like the bee, a long, slender, black body, and a three-forked tail, consisting of bristles; the two outermost black, and the middlemost red. This fly receives its name from the little quadruped, which is found to be so destructive to the crocodile, as it bears a strong similitude in its courage and rapacity.

Though this instrument is, to all appearance, slender and feeble, yet it is found to be a weapon of great force and efficacy. There is scarcely any substance which it will not pierce; and indeed it is seldom seen but employed in penetration. This is the weapon of defence; this is employed in destroying its prey; and still more, by this the animal deposits her eggs wherever she thinks fit to lay them. As it is an instrument chiefly employed for this purpose, the male is unprovided with such a sting, while the female uses it with great force and dexterity, brandishing it when caught, from side to side, and very often wounding those who thought they held her with the greatest security.

All the flies of this tribe are produced in the same manner, and owe their birth to the destruction of some other insect, within whose body they have been deposited, and upon whose vitals they have preyed, till they come to maturity. There is no insect whatever, which they will not attack, in order to leave their fatal present in its body; the caterpillar, the gnat, and even the spider himself, so formidable to others, is often made the unwilling fosterer of this destructive progeny.

About the middle of the summer, when other insects are found in great abundance, the ichneumon is seen flying busily about, and seeking proper objects upon whom to deposit its progeny. As there are various kinds of this fly, so they seem to have various appetites. Some are found to place their eggs within the aurelia of some nascent insect, others place them within the nest, which the wasp had curiously contrived for its own young: and as both are produced at the same time, the young of the ichneumon not only devours the young wasp, but the whole supply of worms which the parent had carefully provided for its provision. But the greatest number of the ichneumon tribe are seen settling upon the back of the caterpillar, and darting, at different intervals, their stings into its body. At every dart they deposit an egg, while the wounded animal seems scarcely sensible of the injury it sustains. In this manner they leave from six to a dozen of their eggs within the fatty substance of the reptile's body, and then fly off to commit further depredations. In the meantime, the caterpillar, thus irreparably injured, seems to feed as voraciously as before; does not abate of its usual activity; and to all appearance, seems no way affected by the internal enemies that are preparing its destruction in their darksome abode. But they soon burst from their egg state, and begin to prey upon the substance of their prison. As they

grow larger, they require a greater supply; till at last the animal, by whose vitals they are supported, is no longer able to sustain them, but dies; its whole inside being almost eaten away. It often happens, however, that it survives their worm-state, and then they change into a chrysalis, inclosed in the caterpillar's body till the time of their delivery approaches, when they burst their prisons, and fly away. The caterpillar, however, is irreparably destroyed, it never changes into a chrysalis, but dies shortly after from the injuries it had sustained.

Such is the history of this fly, which, though very terrible to the insect tribe, fails not to be of infinite service to mankind. The millions which it kills in a single summer are inconceivable; and without such a destroyer, the fruits of the earth would only rise to furnish a banquet for the insect race, to the exclusion of all the nobler ranks of animated nature.

CHAP. V.

OF THE ANT.

Though the number of two-winged flies be very great, and the naturalists have taken much pains to describe their characters and varieties; yet there is such a similitude in their forms and manners, that in a work like this, one description must serve for all. We now, therefore, come to a species of four-winged insects, that are famous from all antiquity for their social and industrious habits, that are marked for their spirit of subordination, that are offered as a pattern of parsimony to the profuse, and of unremitting diligence to the sluggard.

In the experiments, however, which have been more recently made, and the observations which have been taken, much of their boasted frugality and precaution seems denied them: the treasures they lay up are no longer supposed intended for future provision; and the choice they make in their stores, seems no way dictated by wisdom. It is indeed somewhat surprising, that almost every writer of antiquity should describe this insect, as labouring in the summer, and feasting upon the produce during the winter. Perhaps, in some of the warmer climates where the winter is mild, and of short continuance, this may take place; but in France and England, these animals can have no manner of occasion for a supply of winter provisions, as they are actually in a state of torpidity during that season.

The common ants of Europe are of two or three different kinds: some red, some black; some with stings, and others without; such as have stings, inflict their wounds in that manner; such as are unprovided with these weapons of defence, have a power of spurting from their hinder parts an acid pungent liquor, which, if it lights upon the skin, inflames and burns it like nettles.[1]

[1] The *formica rufa*, or wood-ant, is the largest of our British ants. It is called the Hill-ant by Gould, the Fallow-ant by the English translator of Huber, and popularly the Pismire. It invariably lives in or near woods and forests. It may be readily distinguished from other ants by the dusky black colour of its head and hinder parts, and the rusty brown of its middle. The structures reared by this species are often of considerable magnitude, and bear no small resemblance to a rook's nest thrown upon the ground, bottom upwards. The exterior of the nest is composed of almost every transportable material which the colonists can find in their vicinity; but the greater portion consists of withered grass and short twigs of trees, piled up in apparent confusion, but with sufficient regularity to render the whole smooth, conical, and sloping towards the base, for the purpose, we may infer, of carrying off rain water. When within reach of a corn-field, they often also pick up grains of wheat, barley, or oats, and carry them to the nest as building materials, and not for food as was believed by the ancients. The coping which forms the exterior of the wood-ant's nest, though only a small portion of the structure, which consists of a great number of interior chambers and galleries, with funnel-shaped avenues leading to them, is one of the most essential parts, and we cannot follow a more delightful guide than the younger Huber, in detailing its formation.

"The labourers," he says, "of which the colony is composed, not only work continually on the outside of their nest, but, differing very essentially from other species, who willingly remain in the interior, sheltered from the sun, they prefer living in the open air, and do not hesitate to carry on, even in our presence, the greater part of their operations. To have an idea how the straw or stubble roof is formed, let us take a view of the ant-hill at its origin, when it is simply a cavity in the earth. Some of its future inhabitants are seen wandering about in search of materials fit for the exterior work, with which, though rather irregularly, they cover up the entrance; whilst others are employed in mixing the earth, thrown up in hollowing the interior, with fragments of wood and leaves, which are every moment brought in by their fellow-assistants; and this gives a certain consistence to the edifice, which increases in size daily. Our little architects leave here and there cavities, where they intend constructing the galleries which are to lead to the exterior, and as they remove in the morning the barriers placed at the entrance of their nest the preceding evening, the passages are kept open during the whole time of its construction. We soon observed the roof to become convex; but we should be greatly deceived did we consider it solid. This roof is destined to include many apartments or stories. Having observed the motions of these little builders through a pane of glass, adjusted against one of their habitations, I am thence enabled to speak with some degree of certainty upon the manner in which they are constructed. I ascertained, that it is by excavating or mining the under portion of their edifice, that they form their spacious halls, low, indeed, and of heavy construction, yet sufficiently convenient for the use to which they are appropriated, that of receiving, at certain hours of the day, the larvæ and pupæ. These halls have a free communication by galleries, made in the same manner. If the materials of which the ant-hill is composed were only interlaced, they would fall into a confused heap every time the ants

The body of an ant is divided into the head, breast, and belly. In the head the eyes are placed, which are entirely black, and under their eyes there are two small horns or feelers, composed of twelve joints, all covered with a fine silky hair. The mouth is furnished with two crooked jaws, which project outwards, in each of which are seen incisors, that look like

attempted to bring them into regular order. This, however, is obviated by their tempering the earth with rain-water, which, afterwards hardened in the sun, so completely and effectually binds together the several substances, as to permit the removal of certain fragments from the ant-hill without any injury to the rest; it, moreover, strongly opposes the introduction of the rain. I never found, even after long and violent rains, the interior of the nest wetted to more than a quarter of an inch from the surface, provided it had not been previously out of repair, or deserted by its inhabitants. The ants are extremely well sheltered in their chambers, the largest of which is placed nearly in the centre of the building; it is much loftier than the rest, and traversed only by the beams that support the ceiling; it is in this spot that all the galleries terminate, and this forms, for the most part, their usual residence. As to the underground portion, it can only be seen when the ant-hill is placed against a declivity; all the interior may be then readily brought in view, by simply raising up the straw-roof. The subterranean residence consists of a range of apartments, excavated in the earth, taking a horizontal direction."

There is this remarkable difference in the nest of the wood-ants, that they do not construct a long covert way as if for concealment, as the yellow and the brown ants do. The wood-ants are not, like them, afraid of being surprised by enemies, at least during the day, when the whole colony is either foraging in the vicinity or employed on the exterior. But the proceedings of the wood-ants at night are well worthy of notice; and when M. Huber began to study their economy, he directed his entire attention to their night proceedings. "I remarked," says he, "that their habitations changed in appearance hourly, and that the diameter of those spacious avenues, where so many ants could freely pass each other during the day, was, as night approached, gradually lessened. The aperture, at length, totally disappeared, the dome was closed on all sides, and the ants retired to the bottom of their nest. In further noticing the apertures of these ant-hills, I fully ascertained the nature of the labour of its inhabitants, of which I could not before even guess the purport; for the surface of the nest presented such a constant scene of agitation, and so many insects were occupied in carrying materials in every direction, that the movement offered no other image than that of confusion. I saw then clearly that they were engaged in stopping up passages; and for this purpose, they at first brought forward little pieces of wood, which they deposited near the entrance of those avenues they wished to close; they placed them in the stubble; they then went to seek other twigs and fragments of wood, which they disposed above the first, but in a different direction, and appeared to choose pieces of less size in proportion as the work advanced. They, at length, brought in a number of dried leaves, and other materials of an enlarged form, with which they covered the roof; an exact miniature of the art of our builders, when they form the covering of any building? Nature, indeed, seems everywhere to have anticipated the inventions of which we boast, and this is doubtless one of the most simple. Our little insects, now in safety in their nest, retire gradually to the interior before the last passages are closed, one or two only remain without, or concealed behind the doors on guard, whilst the rest either take their repose, or engage in different occupations in the most perfect security. I was impatient to know what took place in the morning upon these ant-hills, and therefore visited them at an early hour. I found them in the same state in which I had left them the preceding evening. A few ants were wandering about on the surface of the nest, some others issued from time to time from under the margin of their little roofs formed at the entrance of the galleries; others afterwards came forth, who began removing the wooden bars that blockaded the entrance, in which they readily succeeded. This labour occupied them several hours. The passages were at length free, and the materials with which they had been closed, scattered here and there over the ant-hill. Every day, morning and evening, during the fine weather, I was a witness to similar proceedings. On days of rain the doors of all the ant-hills remained closed. When the sky was cloudy in the morning, or rain was indicated, the ants, who seemed to be aware of it, opened but in part their several avenues, and immediately closed them when the rain commenced."

The galleries and chambers which are roofed in as thus described, are very similar to those of the mason-ants, being partly excavated in the earth, and partly built with the clay thence procured. It is in these they pass the night, and also the colder months of the winter, when they become torpid or nearly so, and of course require not the winter granaries of corn with which the ancients fabulously furnish them.

The *Carpenter-Ants*, or ants that work in wood, perform much more extensive operations than any of the other carpenter insects. Their only tools, like those of bees and wasps, are their jaws or mandibles; but though these may not appear so curiously constructed as the ovipositor file of the tree-hopper, or the rasp and saw of the saw-flies, they are no less efficient in the performance of what is required. Among the carpenter-ants the emmet or jet-ant holds the first rank, and is easily known by being rather less in size than the wood-ant, and by its fine shining black colour. It is less common in Britain than the others, though its colonies may occasionally be met with in the trunks of decaying oak or willow trees in hedges.

Among the foreign ants, we may mention a small yellow ant of South America, described by Dampier, which seems, from his account, to construct a nest of green leaves. "Their sting," he says, "is like a spark of fire; and they are so thick among the boughs in some places, that one shall be covered with them before he is aware. These creatures have nests on great trees, placed on the body between the limbs; some of their nests are as big as a hogshead. This is their winter habitation; for in the wet season they all repair to these their cities, where they preserve their eggs. In the dry season, when they leave their nests, they swarm all over the woodlands, for they never trouble the savannahs. Great paths, three or four inches broad, made by them, may be seen in the woods. They go out light, but bring home heavy loads on their backs, all of the same substance, and equal in size. I never observed any thing besides pieces of green leaves, so big that I could scarcely see the insect for his burden; yet they would march stoutly, and so many were pressing forward that it was a very pretty sight, for the path looked perfectly green with them.

Ants observed in New South Wales, by the gentlemen in the expedition under Captain Cook, are still more interesting. "Some," we are told, "are as green as a leaf, and live upon trees, where they build their nests of various sizes, between that of a man's head and his fist. These nests are of a very curious structure: they are formed by bending down several of the leaves, each of which is as broad as a man's hand, and glueing the points

teeth. The breast is covered with a fine silky hair, from which project six legs, that are pretty strong and hairy, the extremities of each armed with two small claws, which the animal uses in climbing. The belly is more reddish than the rest of the body, which is of a brown chestnut colour, shining as glass, and covered with extremely fine hair.

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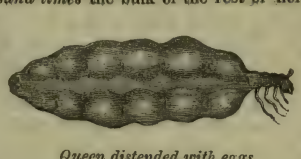
of them together so as to form a purse. The viscous matter used for this purpose is an animal juice which nature has enabled them to elaborate. Another sort are quite black. Their habitations are the inside of the branches of a tree which they contrive to excavate, by working out the pith almost to the extremity of the slenderest twig, the tree at the same time flourishing as if it had no such inmate. A third kind we found nested in the root of a plant, which grows on the bark of trees in the manner of misletoe, and which they had perforated for that use. This root is commonly as big as a large turnip, and sometimes much bigger. When we cut it we found it intersected by innumerable winding passages, all filled with these animals, by which, however, the vegetation of the plant did not appear to have suffered any injury. We never cut one of these roots that was not inhabited, though some were not bigger than a hazel-nut. The animals themselves are very small, not more than half as big as the common red ant in England. They had stings, but scarcely force enough to make them felt; they had, however, a power of tormenting us in an equal, if not in a greater degree; for the moment we handled the root, they swarmed from innumerable holes, and running about those parts of the body that were uncovered, produced a titillation more intolerable than pain, except it is increased to great violence."

The species called *Sugar-Ants* in the West Indies are particularly destructive to the sugar-cane, as well as to lime, lemon, and orange-trees, by excavating their nests at the roots, and so loosening the earth that they are frequently uprooted and blown down by the winds. If this does not happen the roots are deprived of due nourishment, and the plants become sickly and die.

But the most extraordinary of ants is the *White-Ants* or Termites, inhabiting the plains of East India, Africa, and South America. Mr Smeathman has given in the Philosophical Transactions a very complete account of these wonderful creatures. He says that they are naturally divided into three orders: first, the working insects, which he distinguishes by the name of *labourers;* second, the fighters, or *soldiers*, which perform no other labour than such as is necessary in defence of the nest; and third, the winged or perfect insects, which are male and female, and capable of multiplying the species. The latter he denotes the *nobility* or *gentry*, because they neither labour nor fight. In their nest or hill, for they build on the surface of the ground, the labourers are always the most numerous, there being at least a hundred labourers for one of the fighting insects, or soldiers. In this state they are about a quarter of an inch in length. The second order, or soldiers, differ in figure from the labourers. These appear to be such insects as have undergone one change towards their perfect state. They are now nearly half an inch in length, and equal in size to about fifteen of the labourers. The shape of the head is likewise greatly changed. In the former state the mouth is evidently formed for gnawing, or for holding bodies; but in this state the jaws being shaped like two sharp awls, a little jagged, are destined solely for piercing or wounding. For these purposes they are well calculated, being as hard as a crab's claw, and placed in a strong horny head, which is larger than all the rest of the body. The insect of the third order, or in its perfect state, is still more remarkable. The head, the thorax, and the abdomen, differ almost in the same parts in the labourers and soldiers. The animals are also now furnished with four large brownish transparent wings, by which they are enabled, at the proper season, to emigrate, and to establish new settlements. They are likewise greatly altered in their size as well as figure, and have acquired the powers of propagating the species. Their bodies now measure nearly three quarters of an inch in length; their wings, from tip to tip, above two inches and a half; and their bulk is equal to that of thirty labourers, or two soldiers. Instead of active, industrious, and rapacious little animals, when they arrive at their perfect state, they become innocent, helpless, and dastardly.

Their numbers are great, but their enemies are still more numerous. They are devoured by birds, by every species of ants, by carnivorous reptiles, and even by the inhabitants of many parts of Africa. After such devastation, it seems surprising that even a single pair should escape. Some, however, are so fortunate; and being found by some of the labouring insects, that are continually running about the surface of the ground under their covered galleries, are elected kings and queens over new states; all those who are not so elected and preserved, certainly perish. The manner in which these labourers protect the happy pair from their innumerable enemies, not only on the day of the massacre of almost all their race, but for a long time after, justifies the use of the term election. The little industrious creatures immediately enclose them in a small chamber of clay suitable to their size, into which at first they leave but one entrance, large enough for themselves and soldiers to go in and out at, but too little for either of the royal pair to use; and when necessity obliges them to make more entrances, they are never larger, so that of course, the voluntary subjects charge themselves with the task of providing for the offspring of their sovereigns, as well as of working and fighting for them, until they have raised a progeny capable at least of dividing the task with them.

About this time a most extraordinary change takes place in the queen; the abdomen begins to extend and enlarge to such an enormous size, that an old queen will sometimes have it so much increased, as to be nearly *two thousand times* the bulk of the rest of her body. It



Queen distended with eggs.

is now of an irregular, oblong shape, and is become one vast matrix full of eggs. When these are perfectly formed, they begin to be protruded, and they come forth so quickly, that about sixty in a minute, or upwards of eighty thousand in twenty-four hours, are deposited. The eggs are immediately taken away by the attendants, and carried to the nurseries: here they are hatched. The young ones are attended and provided with every thing necessary, until they are able to shift for themselves, and take their share in the labours of the community.

The nests, or rather hills of these ants, (for they are often elevated ten or twelve feet above the surface of the ground,) are nearly of a conical shape; and sometimes so numerous, as at a little distance to appear like little villages of the Negroes. (See a representation of ant-hills in plate I. fig. 1.) Jobson, in his history of Gambia, says that some of them are twenty feet high, and that he and his companions have often hidden themselves behind them, for the purpose of shooting deer and other wild animals. Each hill is composed of an exterior and interior part. The exterior cover is a large clay shell, shaped like a dome, of strength and magnitude sufficient

From such a formation, this animal seems bolder and more active, for its size, than any other of the insect tribe, and fears not to attack a creature often above ten times its own magnitude.

As soon as the winter is past, in the first fine day in April, the ant-hill, that before seemed a desert, now swarms with new life, and myriads of these insects are seen just awaked from their annual lethargy, and pre-

to enclose and protect the interior building from the injuries of the weather, and to defend its numerous inhabitants from the attacks of natural or accidental enemies. Different species of termites construct nests of very different forms. In the plate referred to, among others, are represented turret-nests, the figures of which resemble a pillar, with a large mushroom for a capital. These turrets are composed of well-tempered black earth, and stand nearly three feet high. One nest is represented cut through with the upper part lying on the ground. When one of these turrets is completed, the insects do not enlarge them, when they become too small, but build another at a short distance. They are so strongly built that they will sooner tear up from the roots than break.

The royal chamber is always situated as near the centre of the building as possible, is generally on a level with the surface of the ground, and of an obtuse oval shape within. In the infant state of the colony it is not above an inch in length: but in time it becomes enlarged to six or eight inches, or more. The entrance into the royal chamber not admitting any animal larger than the labourers or soldiers, it follows that the king and queen can never possibly get out. This chamber is surrounded by a hundred of others, of different sizes, figures, and dimensions; all of them arched either in a circular or an elliptical form. These either open into each other, or have communicating passages, which being always clear, are evidently intended for the convenience of the soldiers and attendants, of whom great numbers are necessary. The latter apartments are joined by the magazines and nurseries. The magazines are chambers of clay, and are at all times well stored with provisions, which to the naked eye seem to consist of the raspings of wood and plants, but, when examined by the microscope, they are found to consist chiefly of the gums or inspissated juices of plants thrown together in small irregular masses.

The magazines are always intermixed with the nurseries, buildings totally different from the rest of the apartments. These are composed entirely of wooden materials, which seem to be cemented with gum. They are invariably occupied by the eggs, and the young ones, which first appear in the shape of labourers. These buildings are exceedingly compact, and are divided into a number of small irregular-shaped chambers, not one of which is half an inch wide. They are placed all around, and as near as possible to the royal apartments. When a nest is in an infant state, the nurseries are close to the royal apartment. But as in process of time the body of the queen enlarges, it becomes necessary, for her accommodation, to augment the dimensions of her chamber. She then likewise lays a greater number of eggs, and requires more attendants: of course it is necessary that both the number and dimensions of the adjacent apartments should be augmented. For this purpose, the small first built nurseries are taken to pieces, rebuilt a little farther off, and made a size larger, and their number at the same time is increased. Thus the animals are continually employed in pulling down, repairing, or rebuilding their apartments; and these operations they perform with wonderful sagacity, regularity, and foresight. The nurseries are enclosed in chambers of clay, like those which contain the provisions; but they are much larger. In the early state of the nest they are not bigger than a hazel-nut; but in great hills they are oftentimes four or five inches across.

The royal chamber, as before observed, is situated as nearly under the apex of the hill as possible, and is sur-

rounded on all sides, both above and below, by what Mr Smeathman calls the *royal apartments*, which contain only those labourers and soldiers that are employed in defence of the common parents. These apartments compose an intricate labyrinth, which extends a foot or more in diameter from the royal chamber on every side. Here the nurseries and magazines of provisions begin; and, being separated by small empty chambers and galleries, which surround them, and communicate with each other, are continued on all sides to the outward shell, and reach up within two-thirds, or three-fourths of its height, leaving an open area in the middle under the dome. This is surrounded by large pointed arches, which are sometimes two or three feet high next to the front of the area, but diminish rapidly as they recede, and are soon lost among the innumerable chambers and nurseries behind them. The inferior building, or assemblage of nurseries, chambers, and passages, has a flattish floor, without any perforation. By this contrivance, if by accident water should penetrate the external dome, the apartments below are preserved from injury. The area has also a flattish floor, which is situated above the royal chamber; it is likewise water-proof, and so constructed, that if water gets admittance, it runs off by subterraneous passages, which are cylindrical, and some of them so much as even thirteen inches in diameter. These subterraneous passages are thickly lined with the same kind of clay of which the hill is composed; they ascend the internal part of the external shell in a spiral form, and winding round the whole building up to the top, intersect and communicate with each other at different heights. From every part of these large galleries, a number of pipes, or smaller galleries, leading to different apartments of the building, proceed. There are likewise a great many which lead downward, by sloping descents, to a considerable depth under the surface of the ground. Other galleries ascend and lead out horizontally on every side, and are also carried under ground, but near the surface, to great distances, for the purpose of foraging.

When a breach is made in one of the walls by an axe or other instrument, the first object that attracts attention is the behaviour of the soldiers or fighting insects. Immediately after the blow is given, a soldier comes out, walks about the breach, and seems to examine the nature of the enemy, or cause of the attack. He then goes into the hill, gives the alarm, and in a short time large bodies rush out as fast as the breach will permit. It is not easy to describe the fury that actuates these fighting insects. In their eagerness to repel the enemy, they frequently tumble down the sides of the hill, but quickly recover themselves, and bite everything they encounter. This biting, joined to the striking of their forceps upon the building, makes a crackling or vibrating noise, which is somewhat shriller and quicker than the ticking of a watch, and may be heard at the distance of several feet. While the attack proceeds they are in the most violent bustle and agitation. If they seize hold of any part of a man's body, they instantly make a wound which gives some pain. When they attack the leg, the stain of blood upon the stocking extends more than an inch in width. They make their hooked jaws meet at the first stroke, and never quit their hold, but suffer themselves to be pulled away piece after piece, without any attempt to escape. On the other hand, if a person keeps out of their reach, and gives them no further disturbance, in less than half an hour they retire into the nest, as if they supposed the monster that damaged their castle had fled. Before the whole of the soldiers have got in, the labouring

paring for the pleasure and fatigues of the season. For the first day they never offer to leave the hill, which may be considered as their citadel, but run over every part of it, as if to examine its present situation, to observe what injuries it has sustained during the rigours of winter,[1] while they slept, and to meditate and settle the labours of the day ensuing.

At the first display of their forces, none but the wingless tribe appears, while those furnished with wings remain at the bottom. These are the working ants that first appear, and that are always destitute of wings; the males and females, that are furnished with four large wings each, are more slow in making their appearance.

Thus, like bees, they are divided into males, females, and the neutral or the working tribe. These are all easily distinguished from each other; the females are much larger than the males; the working ants are the smallest of all. The two former have wings; which, however, they sometimes are divested of; the latter never have any, and upon them are devolved all the labours that tend to the welfare of the community. The female, also, may be distinguished by the colour and structure of her breast, which is a little more brown than that of the common ant, and a little brighter than that of the male.

In eight or ten days after their first appearance, the labours of the hill are in some forwardness; the males and females are seen mixed with the working multitude, and pursued or pursuing each other. They seem no way to partake in the common drudgeries of the state; the males pursue the females with great assiduity, and in a manner force them to compliance. They remain coupled for some time; while the males, thus united, suffer themselves to be drawn along by the will of their partners.

In the meantime, the working body of the state take no part in their pleasures; they are seen diligently going from the ant-hill in pursuit of food for themselves and their associates, and of proper materials for giving a comfortable retreat to their young, or safety to their habitation. In the fields of England, ant-hills are formed with but little apparent regularity. In the more southern provinces of Europe, they are constructed with wonderful contrivance, and offer a sight highly worthy a naturalist's curiosity. These are generally formed in the neighbourhood of some large tree and a stream of water. The one is considered by the animals as the proper place for getting food; the other for supplying them with moisture, which they cannot well dispense with. The shape of the ant-hill is that of a sugar-loaf, about three feet high, composed of various substances; leaves, bits of wood, sand, earth, bits of gum, and grains of corn. These are all united into a compact body, perforated with galleries down to the bottom, and winding ways within the body of the structure. From this retreat, to the water, as well as to the tree, in different directions, there are many paths worn by constant assiduity, and along these the busy insects are seen passing and repassing continually; so that from May, or the beginning of June, according to the state of the season, they work continually, till the bad weather comes on.

The chief employment of the working ants is in sustaining not only the idlers at home, but also finding a sufficiency of food for themselves. They live upon various provisions, as well of the vegetable as of the animal kind. Small insects they will kill and devour: sweets of all kinds they are particularly fond of. They seldom, however, think of their community, till they themselves are first satiated. Having found a juicy fruit, they swallow what they can, and then tearing it in pieces, carry home their load. If they meet with an insect above their match, several of them will fall upon it at once, and, having

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insects are all in motion, and hastening towards the breach, each of them having a quantity of tempered mortar in his mouth. This mortar they stick upon the breach as fast as they arrive, and perform the operation with so much despatch and facility, that, notwithstanding the immensity of their number, they never stop or embarrass one another. During this scene of apparent hurry and confusion, the spectator is agreeably surprised, by observing a regular wall rising and gradually filling up the chasm. While the labourers are thus employed, almost all the soldiers remain within, except here and there one, who saunters about among six hundred or a thousand labourers, but never touches the mortar. One soldier, however, invariably takes his station close to the wall which the labourers are building. This soldier turns himself leisurely on all sides, and, at intervals of a minute or two, raises his head, beats upon the building with his forceps, and makes the vibrating noise formerly mentioned. A loud hiss instantly issues from the inside of the dome, and all the subterraneous caverns and passages. That this hiss proceeds from the labourers is apparent; for, at every signal of this kind, they work with redoubled quickness and alacrity. A renewal of the attack, however, instantly changes the scene. "On the first stroke," Mr Smeathman remarks, "the labourers run into the many pipes and galleries with which the building is perforated, which they do so quickly, that they seem to vanish; for in a few seconds, all are gone, and the soldiers rush out as numerous and as vindictive as before. On finding no enemy, they return again leisurely into the hill; and, soon after, the labourers appear loaded as at first, as active, and as sedulous, with soldiers here and there among them, who act just in the same manner, one or other of them giving the signal to hasten the business. Thus the pleasure of seeing them out to fight or to work alternately may be obtained as often as curiosity excites, or time permits; and it will certainly be found, that the one order never attempts to fight, nor the other to work, let the emergency be ever so great."

[1] Memoires pour servir a l'Histoire des Insectes par Charles de Geer.

mangled it, each will carry off a part of the spoil. If they meet, in their excursions, any thing that is too heavy for one to bear, and yet which they are able to divide, several of them will endeavour to force it along, some dragging and others pushing. If any one of them happens to make a lucky discovery, it will immediately give advice to others, and then, at once the whole republic will put themselves in motion. If in these struggles one of them happens to be killed, some kind survivor will carry him off to a great distance, to prevent the obstructions his body might give to the general spirit of industry.

But while they are thus employed in supporting the state in feeding abroad, and carrying in provisions to those that continue at home, they are not unmindful of posterity. After a few days of fine weather, the female ants begin to lay their eggs, and those are as assiduously watched and protected by the working ants, who take upon themselves to supply whatever is wanting to the nascent animal's convenience or necessity. They are carried, as soon as laid, to the safest situation, at the bottom of their hill, where they are carefully defended from cold and moisture. We are not to suppose, that those white substances which we so plentifully find in every ant-hill, are the eggs as newly laid. On the contrary, the ant's egg is so very small, that, though laid upon a black ground, it can scarcely be discerned. The little white bodies we see are the young animals in their maggot state, endued with life, long since freed from the egg, and often involved in a cone, which it has spun round itself, like the silk-worm. The real egg when laid, if viewed through a microscope, appears smooth, polished, and shining, while the maggot is seen composed of twelve rings, and is often larger than the ant itself.—It is impossible to express the fond attachment which the working ants show to their rising progeny. In cold weather they take them in their mouths, but without offering them the smallest injury, to the very depths of their habitation, where they are less subject to the severity of the season. In a fine day they remove them with the same care nearer the surface, where their maturity may be assisted by the warm beams of the sun. If a formidable enemy should come to batter down their whole habitation, and crush them by thousands in the ruin, yet these wonderful insects, still mindful of their parental duties, make it their first care to save their offspring. They are seen running wildly about, and different ways, each loaded with a young one, often bigger than the insect that supports it. I have kept, says Swammerdam, several of the working ants in my closet, with their young in a glass filled with earth. I took pleasure in observing, that in proportion as the earth dried on the surface, they dug deeper and deeper to deposit their eggs; and when I poured water thereon, it was surprising to see with what care, affection, and diligence, they laboured, to put their brood in safety, in the driest place. I have seen also, that when water has been wanting for several days, and when the earth was moistened after it a little, they immediately carried their young ones to have a share, who seemed to enjoy and suck the moisture.

When the young maggot is come to its full growth, the breast swells insensibly, it casts its skin, and loses all motion. All the members which were hidden before, then begin to appear; an aurelia is formed, which represents very distinctly all the parts of the animal, though they are yet without motion, and, as it were, wrapped up in swaddling clothes. When at length the little insect has passed through all its changes, and acquired its proper maturity, it bursts this last skin, to assume the form it is to retain ever after. Yet this is not done by efforts of the little animal alone, for the old ones very assiduously break open, with their teeth, the covering in which it is enclosed. Without this assistance the aurelia would never be able to get free, as M. de Geer often found, who tried the experiment by leaving the aurelias to themselves. The old ones not only assist them, but know the very precise time for lending their assistance; for, if produced too soon, the young one dies of cold: if retarded too long, it is suffocated in its prison.

When the female has done laying, and the whole brood is thus produced, her labours, as well as that of the male, become unnecessary; and her wings, which she had but a short time before so actively employed, drop off. What becomes of her when thus divested of her ornaments is not well known, for she is seen in the cells for some weeks after. The males, on the other hand, having no longer any occupation at home, make use of those wings with which they have been furnished by nature, and fly away, never to return or be heard of more. It is probable they perish with the cold, or are devoured by the birds, which are particularly fond of this petty prey.

In the meantime, the working ants, having probably deposed their queens, and being deserted by the males, that served but to clog the community, prepare for the severity of the winter, and bury their retreats as deep in the earth as they conveniently can. It is now found that the grains of corn, and other substances with which they furnish their hill, are only meant as fences to keep off the rigours of the weather, not as provisions to support them during its continuance. It is found generally

to obtain, that every insect that lives a year after it is come to its full growth, is obliged to pass four or five months without taking any nourishment, and will seem to be dead all that time. It would be to no purpose, therefore, for ants to lay up corn for the winter, since they lie that time without motion, heaped upon each other, and are so far from eating, that they are utterly unable to stir. Thus, what authors have dignified by the name of a magazine, appears to be no more than a cavity, which serves for a common retreat when the weather forces them to return to their lethargic state.

What has been said with exaggeration of the European ant, is however true, if asserted of those of the tropical climates. They build an ant-hill with great contrivance and regularity, they lay up provisions, and as they probably live the whole year, they submit themselves to regulations entirely unknown among the ants of Europe.

Those of Africa are of three kinds, the red, the green, and the black; the latter are above an inch long, and in every respect a most formidable insect. Their sting produces extreme pain, and their depredations are sometimes extremely destructive. They build an ant-hill of a very great size, from six to twelve feet high; it is made of viscous clay, and tapers into a pyramidal form. This habitation is constructed with great artifice; and the cells are so numerous and even, that a honeycomb scarce exceeds them in number and regularity.

The inhabitants of this edifice seem to be under a very strict regulation. At the slightest warning they will sally out upon whatever disturbs them; and if they have time to arrest their enemy, he is sure to find no mercy. Sheep, hens, and even rats, are often destroyed by these merciless insects, and their flesh devoured to the bone. No anatomist in the world can strip a skeleton so completely as they; and no animal, how strong soever, when they have once seized upon it, has power to resist them.

It often happens that these insects quit their retreat in a body, and go in quest of adventures. "During my stay," says Smith, "at Cape Corse Castle, a body of these ants came to pay us a visit in our fortification. It was about day-break when the advanced guard of this famished crew entered the chapel, where some negro servants were asleep upon the floor. The men were quickly alarmed at the invasion of this unexpected army, and prepared, as well as they could, for a defence. While the foremost battalion of insects had already taken possession of the place, the rear-guard was more than a quarter of a mile distant. The whole ground seemed alive, and crawling with unceasing destruction. After deliberating a few moments upon what was to be done, it was resolved to lay a large train of gunpowder along the path they had taken: by this means, millions were blown to pieces; and the rear-guard perceiving the destruction of their leaders, thought proper instantly to return and make back to their original habitation."

The order which these ants observe, seems very extraordinary; whenever they sally forth, fifty or sixty larger than the rest are seen to head the band, and conduct them to their destined prey. If they have a fixed spot where their prey continues to resort, they then form a vaulted gallery, which is sometimes a quarter of a mile in length; and yet they will hollow it out in the space of ten or twelve hours.

CHAP. VI.

OF THE BEETLE, AND ITS VARIETIES.

Hitherto we have been treating of insects with four transparent wings, we now come to a tribe with two transparent wings, with cases that cover them close while at rest, but which allow them their proper play when flying. The principal of these are the Beetle, the May-bug, and the Cantharis. These are all bred like the rest of their order, first from eggs, then they become grubs, then a chrysalis, in which the parts of the future fly are distinctly seen; and, lastly, the animal leaves its prison, breaking forth as a winged animal in full maturity.

Of the Beetle there are various kinds; all, however, concurring in one common formation of having cases to their wings, which are the more necessary to those insects, as they often live under the surface of the earth, in holes which they dig out by their own industry. These cases prevent the various injuries their real wings might sustain, by rubbing or crushing against the sides of their abode. These, though they do not assist flight yet keep the internal wings clean and even, and produce a loud buzzing noise when the animal rises in the air.

If we examine the formation of all animals of the beetle kind, we shall find, as in shell-fish, that their bones are placed externally and their muscles within. These muscles are formed very much like those of quadrupeds, and are endued with such surprising strength, that, bulk for bulk, they are a thousand times stronger than those of a man.—The strength of these muscles is of use in digging the animal's subterraneous abode, where it is most usually hatched, and to which it most fre-

quently returns, even after it becomes a winged insect capable of flying.

Beside the difference which results from the shape and colour of these animals, the size also makes a considerable one; some beetles being not larger than the head of a pin, while others, such as the elephant beetle, are as big as one's fist. But the greatest difference among them is, that some are produced in a month, and in a single season go through all the stages of their existence; while others take near four years to their production, and live as winged insects a year more. To give the history of all these animals, that are bred pretty much in the same way, would be insipid and endless; it will suffice to select one or two from the number, the origin of which may serve as specimens of the rest. I will, therefore, offer the history of the May-bug to the reader's attention; premising that most other beetles, though not so long lived, are bred in the same manner.

The May-bug, or dorr-beetle, as some call it, has, like all the rest, a pair of cases to its wings, which are of a reddish brown colour, sprinkled with a whitish dust, which easily comes off. In some years their necks are seen covered with a red plate, and in others with a black; these, however, are distinct sorts, and their difference is by no means accidental. The fore-legs are very short, and the better calculated for burrowing in the ground, where this insect makes its retreat. It is well known, for its evening buzz, to children; but still more formidably introduced to the acquaintance of husbandmen and gardeners; for, in some seasons, it has been found to swarm in such numbers as to eat up every vegetable production.

The two sexes in the May-bug are easily distinguished from each other, by the superior length of the tufts, at the end of the horns, in the male. They begin to copulate in summer; and at that season they are seen joined together a considerable time. The female being impregnated, quickly falls to boring a hole into the ground where to deposit her burden. This is generally about half a foot deep, and in it she places her eggs, which are of an oblong shape, with great regularity, one by the other. They are of a bright yellow colour, and no way wrapped up in a common covering, as some have imagined. When the female is lightened of her burden she again ascends from her hole, to live as before upon leaves and vegetables, to buzz in the summer evening, and to lie hid among the branches of trees in the heat of the day.

In about three months after these eggs have been thus deposited in the earth, the contained insect begins to break its shell, and a small grub or maggot crawls forth, and feeds upon the roots of whatever vegetable it happens to to be nearest.

All substances of this kind seem equally grateful, yet it is probable the mother insect has a choice among what kind of vegetables she shall deposit her young. In this manner these voracious creatures continue in the worm state, for more than three years, devouring the roots of every plant they approach, and making their way under ground, in quest of food, with great dispatch and facility. At length they grow to above the size of a walnut, being a great thick white maggot with a red head, which is seen most frequently in new-turned earth, and which is so eagerly sought after by birds of every species. When largest, they are found an inch and a half long, of a whitish yellow colour, with a body consisting of twelve segments or joints, on each side of which there are nine breathing-holes, and three red feet. The head is large in proportion to the body, of a reddish colour, with a pincer before, and a semi-circular lip, with which it cuts the roots of plants, and sucks out their moisture. As this insect lives entirely under ground, it has no occasion for eyes, and accordingly it is found to have none; but is furnished with two feelers, which, like the crutch of a blind man, serve to direct its motion. Such is the form of this animal, that lives for years in the worm state under ground, still voracious, and every year changing its skin.

It is not till the end of the fourth year, that this extraordinary insect prepares to emerge from its subterraneous abode, and even this is not effected but by a tedious preparation. About the latter end of autumn, the grub begins to perceive the approach of its transformation; it then buries itself deeper and deeper in the earth, sometimes six feet beneath the surface, and there forms itself a capacious apartment, the walls of which it renders very smooth and shining by the excretions of its body, its abode being thus formed, it begins, soon after, to shorten itself, to swell, and to burst its last skin, in order to assume the form of a chrysalis. This, in the beginning, appears of a yellowish colour, which heightens by degrees, till at last it is seen nearly red. Its exterior form plainly discovers all the vestiges of the future winged insect, all the foreparts being distinctly seen; while behind, the animal seems as if wrapped in swaddling clothes.

The young May-bug continues in this state for about three months longer; and it is not till the beginning of January, that the aurelia divests itself of all its impediments, and becomes a winged insect, completely formed. Yet still the animal is far from attaining its natural strength, health and appetite. It undergoes a kind of infant imbecility; and, un-

like most other insects, that the instant they become flies are arrived at their state of full perfection, the May-bug continues feeble and sickly. Its colour is much brighter than in the perfect animal, all its parts are soft, and its voracious nature seems, for a while, to have entirely forsaken it. As the animal is very often found in this state, it is supposed, by those unacquainted with its real history, that the old ones of the former season have buried themselves for the winter, in order to revisit the sun the ensuing summer. But the fact is, the old one never survives the season, but dies, like all the other winged tribe of insects, from the severity of cold in winter.

About the latter end of May, these insects, after having lived for four years under ground, burst from the earth, when the first mild evening invites them abroad. They are at that time seen rising from their long imprisonment, from living only upon roots, and imbibing only the moisture of the earth, to visit the mildness of the summer air, to choose the sweetest vegetables for their banquet, and to drink the dew of the evening. Wherever an attentive observer then walks abroad, he will see them bursting up before him in his pathway, like ghosts on a theatre. He will see every part of the earth, that had its surface beat into hardness, perforated by their egression. When the season is favourable for them, they are seen by myriads buzzing along, hitting against every object that intercepts their flight. The mid-day sun, however, seems too powerful for their constitutions; they then lurk under the leaves and branches of some shady tree; but the willow seems particularly their most favourite food; there they lurk in clusters, and seldom quit the tree till they have devoured all its verdure. In those seasons which are favourable to their propagation, they are seen in an evening as thick as flakes of snow, and hitting against every object with a sort of capricious blindness. Their duration, however, is but short, as they never survive the season. They begin to join shortly after they have been let loose from their prison, and when the female is impregnated, she cautiously bores a hole in the ground, with an instrument fitted for that purpose, which she is furnished with at the tail, and there deposits her eggs, generally to the number of threescore. If the season and the soil be adapted to their propagation, these soon multiply as already described, and go through the noxious stages of their contemptible existence. This insect, however, in its worm state, though prejudicial to man, makes one of the chief repasts of the feathered tribe, and is generally the first nourishment with which they supply their young. Rooks and hogs are particularly fond of these worms, and devour them in great numbers. The inhabitants of the county of Norfolk, some time since, went into the practice of destroying their rookeries, but in proportion as they destroyed one plague, they were pestered with a greater; and these insects multiplied in such an amazing abundance, as to destroy not only the verdure of the fields, but even the roots of vegetables not yet shot forth. One farm in particular was so injured by them in the year 1751, that the occupier was not able to pay his rent, and the landlord was content not only to lose his income for that year, but also gave money for the support of the farmer and his family. In Ireland they suffered so much by these insects, that they came to a resolution of setting fire to a wood of some miles in extent, to prevent their mischievous propagation.[1]

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[1] *Grubs.*—We frequently, (says Mr Rennie, in his interesting work on Insect Transformations,) hear farmers and gardeners complaining that their produce is destroyed by "*the* grub;" they might with equal propriety accuse "*the* bird" when their ripe seeds are devoured by sparrows, chaffinches, linnets, and other seed-eaters. Instead of one sort of grub, as the expression seems to indicate, we are far under the mark in reckoning a thousand species indigenous to Britain, each peculiar in its food and its manners. We shall, however, adhere as nearly as possible to the terms in common use; but as the larvæ of the crane-flies (*Tipulidæ* Leach), being without legs, cannot be accurately ranked with the legged grubs of beetles, we shall consider them as maggots, though they are usually termed grubs by the farmers.

The most destructive, perhaps, of the creatures usually called grubs, are the larvæ of the may-bug or cockchafer (*Melolontha vulgaris*), but too well known, particularly in the southern and midland districts of England, as well as in Ireland, where the grub is called the Connaught worm; but fortunately not abundant in the north. We only once met with the cockchafer in Scotland, at Sorn, in Ayrshire. Even in the perfect state, this insect is not a little destructive to the leaves of both forest and fruit trees. In 1823, we remember to have observed almost all the trees about Dulwich and Camberwell defoliated by them; and Salisbury says, the leaves of the oaks in Richmond Park were so eaten by them, that scarcely an entire leaf was left. But it is in their previous larvæ state that they are most destructive, as we shall see by tracing their history.

The mother cockchafer, when about to lay her eggs, digs into the earth of a meadow or corn-field to the depth of a span, and deposits them in a cluster at the bottom of the excavation. Rösel, in order to watch their proceedings, put some females into glasses half-filled with earth, covered with a tuft of grass, and a piece of thin muslin. In a fortnight, he found some hundreds of eggs deposited, of an oval shape and a pale yellow colour. Placing the glass in a cellar, the eggs were hatched towards autumn, and the grubs increased remarkably in size. In the following May they fed so voraciously that they required a fresh turf every second day; and even this proving too scanty provender, he sowed in several garden pots a crop of peas, lentils, and salad, and when the plants came up, he put a pair of grubs in each pot; and in this manner he fed them through the second and third years. During this period, they cast their skins three or four times, going for this purpose deeper into the earth, and burrowing out a hole where they might effect their change undisturbed; and they do the same in winter, during which they become torpid and do not eat.

Of all the beetle kind this is the most numerous, and therefore deserves the chief attention of history. The numerous varieties of other kinds might repay the curiosity of the diligent observer, but we must be content in general to observe, that in the great outlines of their history, they resemble those of which we have just been giving a description; like them

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When the grub changes into a pupa, in the third autumn after it is hatched, it digs a similar burrow about a yard deep; and when kept in a pot, and prevented from going deep enough, it shows great uneasiness and often dies. The perfect beetle comes forth from the pupa in



Transformations of the cockchafer (*Melolontha vulgaris*). *a*, newly hatched larvæ. *b*, larvæ, one year old. *c*, the same larvæ at the second year of its growth. *d*, the same three years old. *e*, section of a bank of earth, containing the chrysalis of the fourth year. *f*, the chafer first emerging from the earth. *g*, the perfect chafer in a sitting posture.

The following (*h*) represents the insect flying.



January or February; but it is then as soft as it was whilst still a grub, and does not acquire its hardness and colour for ten or twelve days, nor does it venture above ground before May, on the fourth year from the time of its hatching. At this time, the beetles may be observed issuing from their holes in the evening, and dashing themselves about in the air as if blind.

During the three summers then of their existence in the grub state, these insects do immense injury, burrowing between the turf and the soil, and devouring the roots of grass and other plants; so that the turf may easily be rolled off, as if cut by a turfing spade, while the soil underneath for an inch or more is turned into soft mould like the bed of a garden. Mr Anderson of Norwich, mentions having seen a whole field of fine flourishing grass so undermined by these grubs, that in a few weeks it became as dry, brittle, and withered as hay. Bingley also tells us that "about sixty years ago, a farm near Norwich was so infested with cockchafers, that the farmer and his servants affirmed they gathered eighty bushels of them; and the grubs had done so much injury, that the court of the city, in compassion to the poor fellow's misfortune, allowed him twenty-five pounds." In the year 1785, a farmer, near Blois, in France, employed a number of children and poor persons to destroy the cockchafers at the rate of two liards a hundred, and in a few days they collected fourteen thousand.

"I remember," says Salisbury, "seeing, in a nursery near Bagshot, several acres of young forest trees, particularly larch, the roots of which were completely destroyed by it, so much so, that not a single tree was left alive." We are doubtful, however, whether this was the grub of the cockchafer, and think it more likely to have been that of the green rose beetle (*Cetonia aurata*), which feeds on the roots of trees.

The grub of an allied genus, the midsummer chafer (*Zantheumia Solstitialis*, Leach), has for the last two years been abundant on Lewisham Hill, Blackheath, doing considerable injury to herbage and garden plants. This beetle may be known from being smaller and paler than the cockchafer, and from its not appearing before midsummer. The grub is very similar.

The best way of preventing the ravages of these insects would be to employ children to collect the perfect insects when they first appear, before they lay their eggs; but when a field is once overrun with the larvæ, nothing can be done with it, except paring and burning the surface, or ploughing it up, and turning in a flock of ducks or other poultry, or a drove of pigs, which are said to eat these grubs, and to fatten on the fare. Drenching the field with stable urine by means of reservoir carts, like those used for watering roads, would, if sufficiently done, both kill the grubs, and beneficially manure the land.

The grub called the *wire worm*, though not very appropriately, is the larvæ of one of the spring or click beetles (*Hemirhipus lineatus*, and *H. obscurus*, Latreille) known by their long flattish body, and their power of springing with a clicking sound out of the hand when caught. In some works on agriculture, the larvæ of a common crane fly (*Tipula oleracea* or *T. crocata*) is called the *wire worm*,—we suppose by mistake. The grubs of the click beetles, just alluded to, are said by Bierscander and by Mr Paul of Starston, Norfolk, who watched their transformations, to continue five years before producing the perfect insect. During this time the grub feeds chiefly on the roots of wheat, rye, oats, barley, and grass; but seems also sometimes to attack the larger roots of potatoes, carrots, and salads. Its ravages are often so extensive as to cut off entire crops of grain. It appears to be most partial to land newly broken up; and has not been found so abundant in meadows and pastures,

all other beetles are bred from the egg, which is deposited in the ground, or sometimes, though seldom, in the barks of trees, they change into a worm; they subsist in that state by living upon the roots of vegetables, or the succulent parts of the bark round them. They generally live a year at least before they change into an aurelia; in that state they are not entirely mo-

unless in fields recently laid down with grass. "The wire worm," says Spence, "is particularly destructive for a few years in gardens recently converted from pasture ground. In the botanic garden at Hull, thus circumstanced, a great proportion of the annuals sown in 1813 were destroyed by it. A very simple and effectual remedy, in such cases, was mentioned to me by Sir Joseph Banks. He recommended that slices of potatoes stuck upon skewers, should be buried near the seeds sown, examined every day, and the wire-worms, which collect upon them in great numbers, destroyed."

The wire worm is long, slender, and very tough and hard; but otherwise it has no resemblance to wire, being whitish in colour, of a flattish form, and jointed or ringed. Its breathing spiracles, two in number, are on the back of its last ring.

An insect of this family (*Elater noctilucus*, Linn.) is exceedingly destructive in the West Indies to the sugar-cane; the grub, according to Humboldt and Bonpland, feeding on its roots and killing the plants. . . . . The insect most destructive to our peas is the pulse beetle (*Bruchus granarius*, Linn.), which sometimes lays an egg on every pea in a pod, which the grub, when hatched, destroys. In the same way, clover seed is often attacked by two or more species of small weevil (*Apion*, Herbst), known by the yellow colour of their thighs or their feet; and when the farmer expects to reap considerable profit, he finds nothing but empty husks.

Great ravages are committed in granaries by the caterpillars of small moths; but these are rivalled in the work of destruction by several species of grubs. One of these grubs is called by the French cadelle (*Trogosita mauritanica*, Olivier), and is reported to have done more damage to housed grain than any other insect.* The pest of the granaries, which is but too well known in this country, is the grain weevil (*Calandra granaria*, Clairville), the same, probably, which is mentioned by Virgil,

> ——— Populatque ingentem farris acervum
> Curculio. *Georg.* i. 87.
>
> ——— The high stacks of corn
> Are wasted by the weevil. *Trapp.*

Kirby and Spence calculate that a single pair of weevils may produce in one season 6000 descendants; and they were told by an extensive brewer that he had collected and destroyed them by bushels,—meaning, no doubt, insects and damaged grain together.

Another beetle grub, popularly called the meal worm, the larvæ of *Tenebrio molitor*, Linn., which lives in that state two years, does no little damage to flour, as well as to bread, cakes, biscuit, and similar articles. Accounts are also given of the ravages committed by the grubs of other beetles, of several species, apparently not well ascertained, upon different sorts of provisions, such as bacon, ham, dried tongues, ship-biscuit, &c. Sparrman tells us, that he has witnessed the ground peas on ship-board so infested with these grubs, that they were seen in every spoonful of the soup. In the case of soup, or of other food which has been exposed to heat, the only inconvenience is the disgust which must ensue; but, unfortunately, there may sometimes occur circumstances of a more serious nature,—from either the eggs or the insects themselves being incautiously swallowed alive. We do not wish, however, to create, so much as to allay, the fears entertained by those who are unacquainted with the habits of insects; and nothing, we are persuaded, will do this more effectually than a statement of facts well ascertained. "Several people," says Abbé de la pluche, "never eat fruit because they believe that spiders and other insects scatter their eggs upon it at random; but even if it were so, as it is not, it would be impossible for the young, should they be hatched in the stomach, to live there for an instant."

Adhering (continues Mr Rennie) to the distinction of terming those larvæ which are destitute of feet, *maggots*, we shall notice here a very destructive one, which is sometimes popularly called *the* grub, and sometimes confounded with the wire worm. We allude to the larva of one or two common species of crane flies (*Tipulidæ*), well known by the provincial names of father-long-legs, Jenny-spinners, and tailors. These insects are so common in some meadows, that, being very shy and fearful of danger, they rise in swarms at every step—some of them flying high, others only skipping over the grass, and others running and using their long legs as the inhabitants of marshy countries use stilts, and employing their wings like the ostrich to aid their limbs.

These flies deposit their eggs in the earth; sometimes in grass fields or moist meadows, and sometimes in the tilled ground of gardens and farms. For this purpose the female is provided with an ovipositor well adapted to the operation, consisting of a sort of pincer or forceps of a horny consistence, and sharp at the point. By pressure, as Réaumur says, the eggs may be extruded from this in the same way as the stone can be easily squeezed out of a ripe cherry.

The eggs are exceedingly small and black, like grains of gunpowder, and each female lays a good many hundreds. The position which she assumes appears somewhat awkward, for she raises herself perpendicularly on her two hind legs, using her ovipositor as a point of support, and resting with her fore legs upon the contiguous herbage. She then thrusts her ovipositor into the ground as far as the first ring of her body, and leaves one or more eggs in the hole; and next moves onwards to another place, but without bringing herself into a horizontal position. The maggot, when hatched from the egg, immediately attacks the roots of the grass and other herbage which it finds nearest to it; and of course the portion of the plant above ground withers for lack of nourishment. In many districts of England these insects cut off a large proportion of the wheat crop, particularly, it would appear, when it has been sown on clover leys.

The maggot of a minute fly of the same family, known by the name of the wheat fly, (*Cecidomyia Tritici*, Kirby), is frequently productive of great damage in the crops of wheat. The parent fly is very small, not unlike a midge (*Culicoides punctata*, Latr.), of an orange colour, and wings rounded at the tip, and fringed with hairs. The female is furnished with a retractile ovipositor, four times as long as the body, and as fine as a hair, for depositing her eggs, which she does in the glumes of the florets of the grain.

The *Hessian fly* of America is a little larger than our wheat fly, more slender in the body, has longer legs, and is not orange, but black and fulvous. The female deposits from one to eight or more eggs on a single plant of wheat, between the sheath of the inner leaf and the stem nearest the roots; in which situation, with its head towards the root or first joint, the young larva passes the winter, eating into the stem, and causing it to break.

The devastation committed by the Hessian fly seems to have been first observed in 1776, and it was erroneously supposed that the insect was conveyed among straw by the Hessian troops from Germany. It was first

* Oliver, ii. 19.

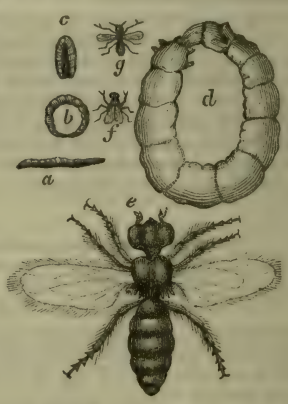
tionless, nor entirely swaddled up without form.

It would be tedious and endless to give a description of all; and yet it would be an unpardonable omission not to mention the particularities of some beetles, which are singular rather from their size, their manners, or their formation. That beetle, which the Americans call the Tumble-dung, particularly demands our attention; it is all over of a dusky black, rounder than those animals are generally found to be, and so strong, though not much larger than the common black beetle, that if one of them be put under a brass candlestick, it will cause it to move backwards and forwards, as if it were by an invisible hand, to the admiration of those who are not accustomed to the sight; but this strength is given it for much more useful purposes than those of exciting human curiosity, for there is no creature more laborious, either in seeking subsistence, or in providing a proper retreat for its young. They are endowed with sagacity to discover subsistence by their excellent smelling, which directs them in flights to excrements just fallen from man or beast, on which they instantly drop, and fall unanimously to work in forming round balls or pellets thereof, in the middle of

noticed in the wheat fields of Long Island, from which it spread gradually at the rate of fifteen or twenty miles round; and in 1789 it had advanced two hundred miles from its original station in Long Island. Other accounts state that it did not travel more than seven miles annually, and did little serious damage before 1788. Their numbers seem almost incredible. The houses in the infested districts swarmed with them to so great a degree, that every vessel was filled with them; five hundred were actually counted on a glass tumbler which had been set down for a few minutes with a little beer in it. They were observed crossing the Delaware river like a cloud; and even mountains do not seem to interrupt their progress. We can well understand, therefore, that so formidable a ravager should have caused a very great alarm; and even our own government was in fear lest the insect should be imported. The privy council, indeed, sat day after day in deep consultation what measures should be adopted to ward off the danger of a calamity more to be dreaded, as they well knew, than the plague or the pestilence. Expresses were sent off in all directions to the officers of the customs at the different outports respecting the examination of cargoes,—despatches were written to the ambassadors in France, Austria, Prussia, and America, to gain information,—and so important altogether was the business deemed, that the minutes of council, and the documents collected from all quarters, fill upwards of two hundred pages.

The cheese fly (*Piophila Casei*, Fallen) is very small and black, with whitish wings margined with black. It was one of those experimented upon by Redi to prove that insects, in the fabric of which so much art, order, contrivance, and wisdom appear, could not be the production of chance or rottenness, but the work of the same Omnipotent hand which created the heavens and the earth. This tiny little fly is accordingly furnished with an admirable instrument for depositing its eggs, in an ovipositor, which it can thrust out and extend to a great length, so that it can penetrate to a considerable depth into the cracks of cheese, where it lays its eggs, 256 in number. "I have seen them myself," says Swammerdam, "thrust out their tails for this purpose to an amazing length, and by that method bury the eggs in the deepest cavities. I found in a few days afterwards a number of maggots which had sprung from those eggs, perfectly resembling those of the first brood that had produced the mother fly. I cannot but also take notice that the rottenness of cheese is really caused by these maggots; for they both crumble the substance of it into small particles and also moisten it with some sort of liquid, so that the decayed part rapidly spreads. I once observed a cheese which I had purposely exposed to this kind of fly grow moist in a short time in those parts of it where eggs had been deposited, and had afterwards been hatched into maggots; though, before, the cheese was perfectly sound and entire."

The cheese-hopper is furnished with two horny claw-shaped mandibles, which it uses both for digging into the cheese and for moving itself, being destitute of feet. Its powers of leaping have been observed by every one; and Swammerdam says, "I have seen one, whose length did not exceed the fourth of an inch, leap out of a box six inches deep, that is, twenty-four times the length of its own body: others leap a great deal higher." For this purpose it first erects itself on its tail, which is furnished with two wart-like projections, to enable it to maintain its balance. It then bends itself into a circle, catches the skin near its tail with its hooked mandibles, and after strongly contracting itself from a circular into an oblong form, it throws itself with a jerk into a straight line, and thus makes the leap.



Cheese hoppers (*Piophila casei*, Fallen). *a*, the maggot extended; *b*, in a leaping position; *d*, the same magnified; *e*, the fly magnified; *f*, *g*, the fly, natural size.

One very surprising provision is remarkable in the breathing-tubes of the cheese maggot, which are not placed, as in caterpillars, along the sides, but a pair near the head and another pair near the tail. Now, when burrowing in the moist cheese, these would be apt to be obstructed; but to prevent this, it has the power of bringing over the front pair a fold of the skin, breathing in the meanwhile through the under pair. Well may Swammerdam denominate these contrivances "surprising miracles of God's power and wisdom in this abject creature."

Like the other destructive insects above mentioned, the multiplication of the cheese fly is checked by some insect, whose history, so far as we are aware, is not yet known. Swammerdam found many of the maggots with other larvæ in their bodies; but he did not trace their transformations. If they were the larva of an ichneumon it must be exceedingly minute.

which they lay an egg. These pellets, in September, they convey three feet deep in the earth, where they lie till the approach of spring; when the eggs are hatched the nests burst, and the insects find their way out of the earth. They assist each other with indefatigable industry, in rolling these globular pellets to the place where they are to be buried. This they are to perform with the tail foremost, by raising up their hinder part, and shoving along the ball with their hind-feet. They are always accompanied with other beetles of a larger size, and of a more elegant structure and colour. The breast of this is covered with a shield of a crimson colour, and shining like metal; the head is of the like colour, mixed with green, and on the crown of the head stands a shining black horn, bended backwards. These are called the kings of the beetles; but for what reason is uncertain, since they partake of the same dirty drudgery with the rest.[1]

[1] The scientific name for beetles is *Coleoptera*. They are readily distinguished, (says Mr Duncan, in the Naturalist's Library,) from other insects, by having the inferior wings covered and protected by a hard case or shell. This peculiarity of structure has suggested the name, which is composed of two Greek words, and signifies *wings in a sheath* (κολεος, a *sheath*, and πτερα, *wings*). The term was first used by Aristotle, and as the character to which it refers forms a very obvious mark of distinction, it has been almost universally adopted by subsequent writers. In several instances, however, it fails to be an accurate definition of the order, for there are some beetles without either wings or sheath, and many others in which the latter only is present. To the other characters more recently added, such as the transverse folding of the wings, and the straight sutural line down the middle of the wingcases, separating them into two equal portions, there are likewise exceptions; but these are too few and unimportant to invalidate materially the general correctness of the definition.

The insects to which these characters apply, constitute one of the most numerous orders of their class. In this country alone, they amount, by the latest and most accurate *census*, to upwards of 3600, thus forming nearly a third part of our entire insect population. This is considerably more than double the number of phanogamous or flowering plants indigenous to Britain, and greatly exceeds the whole amount of our native vertebrate animals. When compared with the two other orders that are next to it in extent in this country, it will be found that the Coleoptera are nearly one half more numerous than the Lepidoptera, and that they stand much in the same relation to the Diptera or two winged flies. Of the latter, indeed, all the species ascertained to inhabit Europe scarcely exceed the amount of British Coleoptera; for the most accurate enumeration of the European Diptera which we possess makes them about 3760. The native Coleoptera of Sweden, according to the enumeration of them given by Gyllenhal, in his admirable *Insecta Suecica*, are about 4700 in number. In advancing southwards, these insects increase in a ratio similar to what is observed in other departments of nature; and in countries under the tropics, so redundant in every kind of animal life, they may be said absolutely to swarm. We are without sufficient data, however, from which to form an accurate estimate of their total amount. Some years since, the collection of the Count de Jean at Paris, one of the most extensive that exists, contained no fewer than 20,000 species. Many others are no doubt to be found in different collections; and when we take into account the discoveries daily made by the numerous cultivators of this branch of zoology, and the extent and fertility of the countries with the insect productions of which we are wholly unacquainted, there seems reason to believe that it cannot be much short of 30,000—that is, 10,000 above the estimate formed by Ray nearly a century and a half ago, as the probable amount of the whole class of insects!

The Elephant-Beetle is the largest of this kind hitherto known, and is found in South America, particularly Guiana and Surinam, as well as about the river Oroonoko. It is of

This order comprehends some of the largest as well as the most minute insects with which we are acquainted. Certain *orthopterous* species belonging to the genus *Phasma* surpass them in length, and several gigantic moths are of greater superficial extent; but in many beetles length of body is combined with a proportionate breadth and thickness, which renders them the most bulky and massive of their class. A fine specimen of Prionus giganteus measures nearly half a foot in length, the breadth is about two inches, and the expansion of the wings is nine inches. A handsome and scarce species of the same family (*Prionus armillatus*) is about five inches long and one inch and three quarters broad, and the antennæ, which are very strong and rigid, are upwards of six inches in length. The Hercules beetle (*Dynastes Hercules*), and Scarabæus Actæon, measure respectively about four and a half inches in length including the horns. The largest coleopterous insects inhabiting Britain are the *Hydröus piceus*, and the Stag-beetle (*Lucanus cervus*). The latter is nearly two inches in length, including the mandibles; and the former is not much short of the same dimensions, besides being of considerably greater breadth. These may be regarded as the giants of this order of insects, occupying one extremity of the scale. At the opposite extremity may be placed some species of the genera Trichopteryx, Atomaria, and Agathidium, which are so minute as not to exceed one-eighth part of a line in length;* or, to adopt an illustration sometimes employed, they are absolutely not bigger than the full stop that closes this period.

The structure of these minute beings is perhaps even more calculated to excite our admiration than that of the larger animals. In the latter, most of the parts are of sufficient size to come within the direct cognisance of our senses, and there is no apparent discrepancy between their dimensions and the functions which they perform; but when we reflect that a mere animated point, almost invisible to the naked eye, possesses all the attributes which belong to the largest of its race—that it is furnished with an external covering made up of many parts adjusted to each other with the nicest accuracy—that it is supplied with all the requisite organs of sense and motion, and has a nervous and respiratory system of greater complexity than many of the larger animals—that the various processes of digestion, assimilation, and secretion, are continually going forward—that not a limb can be put in motion without calling into play a multitude of muscles—and that this atomic being is moreover endowed with instincts which regulate with almost unerring certainty all its habits and economy—we can scarcely fail to regard it as affording a more striking instance of consummate skill than if it had occupied a much larger space.

> "The shapely limb, and lubricated joint,
> Within the small dimensions of a point,
> Muscle and nerve miraculously spun,
> His mighty work, who speaks and it is done;
> The invisible in things scarce seen revealed,
> To whom an atom is an ample field."

* A line is the twelfth part of a French inch.

a black colour, and the whole body is covered with a very hard shell, full as thick and as strong as that of a small crab. Its length, from the hinder part to the eyes, is almost four inches, and from the same part to the end of the proboscis, or trunk, four inches and three quarters. The transverse diameter of the body is two inches and a quarter, and the breadth of each elytron, or case for the wings, is an inch and three-tenths. The antennæ, or feelers, are quite horny ; for which reason the proboscis, or trunk, is movable at its insertion into the head, and seems to supply the place of feelers. The horns are eight-tenths of an inch long, and terminate in points. The proboscis is an inch and a quarter long, and turns upwards, making a crooked line, terminating in two horns, each of which is near a quarter of an inch long ; but they are not perforated at the end like the proboscis of other insects. About four-tenths of an inch above the head, on that side next the body, is a prominence or small horn, which, if the rest of the trunk were away, would cause this part to resemble the horn of a rhinoceros. There is indeed a beetle so called, but then the horns or trunk has no fork at the end, though the lower horn resembles this. The feet are all forked at the end, but not like lobster's claws.

To this class we may also refer the Glow-worm, that little animal which makes such a distinguished figure in the descriptions of our poets. No two insects can differ more than the male and female of this species from each other. The male is in every respect a beetle, having cases to its wings, and rising in the air at pleasure ; the female, on the contrary, has none, but is entirely a creeping insect, and is obliged to wait the approaches of her capricious companion. The body of the female has eleven joints, with a shield breast-plate, the shape of which is oval ; the head is placed over this, and is very small, and the three last joints of her body are of a yellowish colour ; but what distinguishes it from all other animals, at least in this part of the world, is the shining light which it emits by night, and which is supposed by some philosophers to be an emanation which she sends forth to allure the male to her company. Most travellers who have gone through sandy countries, must well remember the little shining sparks with which the ditches are studded on each side of the road. If incited by curiosity to approach more nearly, he will find this light sent forth by the glow-worm ; if he should keep the little animal for some time, its light continues to grow paler, and at last appears totally extinct. The manner in which this light is produced has hitherto continued inexplicable ; it is probable the little animal is supplied with some electrical powers, so that by rubbing the joints of its body against each other, it thus supplies a stream of light, which if it allures the male, as we are told, serves for very useful purposes.[1]

If superiority in certain qualities must be conceded to some other tribes of insects, the Coleoptera certainly surpass them all, as well as the higher races of animals, in variety of form and singularity of structure. Among butterflies, the *Hymenoptera*, and two-winged flies, nearly as great a uniformity of outline prevails as in the case of birds and serpents. But there appears to be no general type of form according to which beetles have been modelled. They differ as widely among themselves in outward appearance, as separate classes of other animated beings do from each other. Even the great deep, which has ever been regarded as the fertile mother of all monstrous and all prodigious things, seldom produces an "odd fish" equal in eccentricity to some species of beetles. If we are less struck with the strange proportion of their parts, than with any unusual figure among the larger animals, it is on account of their small size, which is generally too inconsiderable to arrest our attention, and leads us to consider them in a great measure abstractedly from the idea of physical power with which we are accustomed to regard animated beings of large dimensions. But for this circumstance, they would excite the astonishment of the most careless observer, and lead us to fear lest they should realize the anticipations of the poet,—

> "Their shape would make them, had they bulk and size,
> More hideous foes then fancy can devise,
> With helmet-heads, and dragon-scales adorned,
> The mighty myriads, now securely scorned,
> Would mock the majesty of man's high birth,
> Despise his bulwarks, and unpeople earth."

—*Naturalist's Library, Vol. II. Beetles. By James Duncan. Edinburgh*, 1835.

[1] We boast of our candles, our wax-lights, and our Argand-lamps, and pity our fellow-men who, ignorant of our methods of producing artificial light, are condemned to pass their nights in darkness. We regard these inventions as the results of a great exertion of human intellect, and never conceive it possible that other animals are able to avail themselves of modes of illumination equally efficient; and are furnished with the means of guiding their nocturnal evolutions by actual lights, similar in their effect to those which we make use of. Yet many insects are thus provided. Some are forced to content themselves with a single candle, not more vivid than the rush-light which glimmers in the peasant's cottage ; others exhibit two or four, which cast a stronger radiance ; and a few can display a lamp little inferior in brilliancy to some of ours. Not that these insects are actually possessed of candles and lamps. You are aware that I am speaking figuratively. But Providence has supplied them with an effectual substitute—a luminous preparation or secretion, which has all the advantages of our lamps and candles, without their inconveniences ; which gives light sufficient to direct their motions, while it is incapable of burning ; and whose lustre is maintained without needing fresh supplies of oil or the application of the snuffers.

Of the insects thus singularly provided, the common glow-worm (*Lampyris noctiluca*) is the most familiar instance. Who that has ever enjoyed the luxury of a summer evening's walk in the country, in the southern parts of our island, but has viewed with admiration these "stars of the earth and diamonds of the night?" And if, living like me in a district where it is rarely met with, the first time you saw this insect, chanced to be, as it was in my case, one of those delightful evenings which

The Cantharis is of the beetle kind, from whence come cantharides, well known in the shops by the name of Spanish flies, and for their use in blisters. They have feelers like bristles, flexible cases to the wings, a breast pretty plain, and the sides of the belly wrinkled. Cantharides differ from each other in their size, shape, and colour; those used in the

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an English summer seldom yields, when not a breeze disturbs the balmy air, and "every sense is joy," and hundreds of these radiant worms, studding their mossy couch with mild effulgence, were presented to your wondering eye in the course of a quarter of a mile—you could not help associating with the name of glow-worm the most pleasing recollections. No wonder that an insect, which chiefly exhibits itself on occasions so interesting, and whose economy is so remarkable, should have afforded exquisite images and illustrations to those poets who have cultivated natural history.

If you take one of these glow-worms home with you for examination, you will find that in shape it somewhat resembles a caterpillar, only that it is much more depressed; and you will observe that the light proceeds from a pale-coloured patch that terminates the underside of the abdomen. It is not, however, the larva of an insect, but the perfect female of a winged beetle, from which it is altogether so different, that nothing but actual observation could have inferred the fact of their being the sexes of the same insect. In the course of your inquiries, you will find that sexual differences even more extraordinary exist in the insect world.

It has been supposed by many that the males of the different species of *Lampyris* do not possess the property of giving out any light; but it is now ascertained that this supposition is inaccurate, though their light is much less vivid than that of the female. Ray first pointed out this fact with respect to *L. noctiluca*. Geoffroy also observed that the male of this species has four small luminous points, two on each of the two last segments of the belly; and his observation has been recently confirmed by Muller. This last entomologist, indeed, saw only two shining spots; but from the insect's having the power of withdrawing them out of sight, so that not the smallest trace of light remains, he thinks it is not improbable that at times two other points still smaller may be exhibited, as Geoffroy has described. In the males of *L. splendidula* and of *L. hemiptera* the light is very distinct, and may be seen in the former while flying. The females have the same faculty of extinguishing or concealing their light—a very necessary provision to guard them from the attacks of the nightingale and other nocturnal birds. Mr White even thinks that they regularly put it out between eleven and twelve every night; and they have also the power of rendering it for awhile more vivid than ordinary.

Authors who have noticed the luminous parts of the common female glow-worm, having usually contented themselves with stating that the light issues from the three last ventral segments of the abdomen. I shall give you the result of some observations I once made upon this subject. One evening, in the beginning of July, meeting with two of these insects, I placed them on my hand. At first their light was exceedingly brilliant, so as to appear even at the junctions of the upper or dorsal segments of the abdomen. Soon after I had taken them, one withdrew its light altogether, but the other continued to shine. While it did this, it was laid upon its back, the abdomen forming an angle with the rest of its body, and the last or anal segment being kept in constant motion. This segment was distinguished by two round and very vivid spots of light; which, in the specimen that had ceased to shine, were the last that disappeared, and they seem to be the first parts that become luminous, when the animal is disposed to yield its light. The penultimate and antepenultimate segments each exhibited a middle transverse band of yellow radiance, terminated towards the trunk by an obtusely-dentated line; a greener and fainter light being emitted by the rest of the segment.

Though many of the females of the different species of *Lampyris* are without wings, and even elytra, (in which circumstance they differ from all other apterous *Coleoptera*,) this is not the case with all. The female of *L. Italica*, a species common in Italy, and which, if we may trust to the accuracy of the account given by Mr Waller in the *Philosophical Transactions* for 1684, would seem to have been taken by him in Hertfordshire, is winged; and when a number of these moving stars are seen to dart through the air in a dark night, nothing can have a more beautiful effect. Dr Smith tells us that the beaus of Italy are accustomed in an evening to adorn the heads of the ladies with these artificial diamonds, by sticking them into their hair; and a similar custom prevails amongst the ladies of India.

Besides the different species of the genus *Lampyris*, all of which are probably more or less luminous, another insect of the beetle tribe, *Elater noctilucus*, is endowed with the same property, and that in a much higher degree. This insect, which is an inch long, and about one-third of an inch broad, gives out its principal light from two transparent eye-like tubercles placed upon the thorax; but there are also two luminous patches concealed under the elytra, which are not visible except when the insect is flying, at which time it appears adorned with four brilliant gems of the most beautiful golden-blue lustre; in fact, the whole body is full of light, which shines out between the abdominal segments when stretched. The light emitted by the two thoracic tubercles alone is so considerable, that the smallest print may be read by moving one of these insects along the lines; and in the West India Islands, particularly in St Domingo, where they are very common, the natives were formerly accustomed to employ these living lamps, which they called *Cucuij*, instead of candles in performing their evening household occupations. In travelling at night, they used to tie one to each great toe; and in fishing and hunting required no other flambeau. Southey has happily introduced this insect in his "*Madoc*," as furnishing the lamp by which Coatal rescued the British hero from the hands of the Mexican priests.

> "She beckoned and descended, and drew out
> From underneath her vest a cage, or net
> It rather might be called, so fine the twigs
> Which knit it, where confined, two fire-flies gave
> Their lustre. By that light did Madoc first
> Behold the features of his lovely guide."

The brilliant nocturnal spectacle presented by these insects to the inhabitants of the countries where they abound, cannot be better described than in the language of the poet above referred to, who has thus related its first effect upon the British visitors of the New World:—

> "Sorrowing we beheld
> The night come on; but soon did night display
> More wonders than it veil'd: innumerous tribes
> From the wood cover swarm'd, and darkness made
> Their beauties visible: one while they streamed
> A bright blue radiance upon flowers that closed
> Their gorgeous colours from the eye of day;
> Now motionless and dark, eluded search,
> Self-shrouded; and anon, starring the sky,
> Rose like a shower of fire."

With regard to the immediate source of the luminous properties of these insects, Mr Macartney, to whom we are indebted for the most recent investigation on the

shops also do the same. The largest in these parts are about an inch long, and as much in circumference, but others are not above three quarters of an inch. Some are of a pure azure colour, others of a pure gold, and others again have a mixture of pure gold and azure colours; but they are all very brilliant, and extremely beautiful. These insects, as is well known,

subject, has ascertained that in the common glow-worm, and in *Elater noctilucus* and *ignitus*, the light proceeds from masses of a substance not generally differing, except in its yellow colour, from the instertitial substance (*corps graisseux*) of the rest of the body, closely applied underneath those transparent parts of the insect's skin which afford the light. In the glow-worm, besides the last-mentioned substance, which, when the season for giving light is passed, is absorbed, and replaced by the common instertitial substance, he observed on the inner side of the last abdominal segment two minute oval sacs formed of an elastic spirally-wound fibre similar to that of the tracheæ, containing a soft yellow substance of a closer texture than that which lines the adjoining region, and affording a more permanent and brilliant light. This light he found to be less under the control of the insect, than that from the adjoining luminous substance, which it has the power of voluntarily extinguishing, not by retracting it under a membrane, as Carradori imagined, but by some inscrutable change dependent upon its will; and when the latter substance was extracted from living glow-worms, it afforded no light, while the two sacs in like circumstances shone uninterruptedly for several hours. Mr Macartney conceives, from the radiated structure of the instertitial substance surrounding the oval yellow masses immediately under the transparent spots in the thorax of *Elater noctilucus*, and the sub-transparency of the adjoining crust, that the instertitial substance in this situation has also the property of shining—a supposition which, if De Geer and other authors be correct in stating that this insect has two luminous patches under its elytra, and that the incisures between the abdominal segments shine when stretched, may probably be extended to the *whole* of the instertitial substance of its body. What peculiar organization contributes to the production of light in the hollow projections of *Fulgora laternaria* and *candelaria*, the hollow antennæ of *Pausus sphærocerus*, and under the whole integument of *Scolopendra electrica*, Mr Macartney was unable to ascertain. Respecting this last he remarks, what I have myself observed, that there is an apparent effusion of a luminous fluid on its surface, that may be received upon the hand, which exhibits a phosphoric light for a few seconds afterwards; and that it will not shine unless it have been previously exposed for a short time to the solar light.*

With respect to the remote cause of the luminous property of insects, philosophers are considerably divided in opinion. The disciples of modern chemistry have, in general, with Dr Darwin, referred it to the slow combustion of some combination of phosphorus secreted from their fluids by an appropriate organization, and entering into combination with the oxygen supplied in respiration. This opinion is very plausibly built upon the ascertained existence of phosphoric acid as an animal secretion; the great resemblance between the light of phosphorus in slow combustion and animal light; the remarkably large spiracula in glow-worms; and upon the statement that the light of the glow-worm is rendered more brilliant by the application of heat and oxygen gas, and is extinguished by cold and by hydrogen and carbonic acid gases. From these last facts, Spallanzani was led to regard the luminous matter as a compound of hydrogen and carbonated hydrogen gas. Carradori having found that the luminous portion of the belly of the Italian glow-worm (*Lampyris italica*) shone in vacuo, in oil, in water, and when under other circumstances where the pressure of oxygen gas was precluded, with Brugnatelli ascribed the property in question to the imbibition of light separated from the food or air taken into the body, and afterwards secreted in a sensible form. Lastly, Mr Macartney having ascertained by experiment that the light of a glow-worm is not diminished by immersion in water, or increased by the application of heat; that the substance affording it, though poetically employed for lighting the fairies' tapers, is incapable of inflammation if applied to the flame of a candle or red-hot iron; and when separated from the body, exhibits no sensible heat on the thermometer's being applied to it—rejects the preceding hypothesis as unsatisfactory, but without substituting any other explanation; suggesting, however, that the facts he observed are more favourable to the supposition of light being a quality of matter than a substance.

Which of these opinions is the more correct, I do not pretend to decide. But though the experiments of Mr Macartney seem fairly to bear him out in denying the existence of any ordinary combination of phosphorus in luminous insects, there exists a contradiction in many of the statements, which requires reconciling before final decision can be pronounced. The different results obtained by Forster and Spallanzani, who assert that glow-worms shine more brilliantly in oxygen gas, and by Beckerheim, Dr Hulme, and Sir H. Davy, who could perceive no such effect, may perhaps be accounted for by the supposition that in the latter instances the insects having been taken more recently, might be less sensible to the stimulus of the gas than in the former, where possibly their irritability was, as Brown would say, accumulated by a longer abstinence: but it is not so easy to reconcile the experiment of Sir H. Davy, who found the light of the glow-worm not to be sensibly diminished in hydrogen gas, with those of Spallanzani and Dr Hulme, who found it to be extinguished by the same gas, as well as by carbonic acid, nitrous and sulphurated hydrogen gases. Possibly some of these contradictory results were occasioned by not adverting to the faculty which the living insect possesses of extinguishing its lights at pleasure; or different philosophers may have experimented on different species of Lampyris.

The general use of this singular provision is not much more satisfactorily ascertained than its nature. I have before conjectured—and in an instance I then related it seemed to be so—that it may be a means of defence against their enemies. In different kinds of insects, however, it may probably have a different object. Thus, in the lantern-flies (*Fulgora*) whose light precedes them, it may act the part that their name imports, enabling them to discover their prey, and to steer themselves safely in the night. In the fire-flies, (*Elater*) if we consider the infinite numbers that in certain climates and situations present themselves every where in the night, it may distract the attention of their enemies or alarm them. And in the glow-worm—since their light is usually most brilliant in the female; in some species, if not all, present only in the season when the sexes are destined to meet; and strikingly more vivid at the very moment when the meeting takes place—besides the above uses, it is most probably intended to conduct the sexes to each other. This seems evidently the design in view in those species in which, as in the common glow-worm, (*L. noctiluca, L.*) the females are apterous. The torch which the wingless female, doomed to crawl upon the grass, lights up at the approach of night, is a beacon which unerringly guides the vagrant male to her

* *Phil. Trans.* 1810, p. 281.—Mr Macartney's statement on this point is not very clear. He probably means that the insect will not shine in a dark place in the *day time*, unless previously exposed to the solar light: for it is often seen to shine at night when it could have had no *recent* exposure to the sun.

are of the greatest benefit to mankind, making a part in many medicines conducive to human preservation. They are chiefly natives of Spain, Italy, and Portugal; but they are to be met with also about Paris in the summer time, upon the leaves of the ash, the poplar, and the rose-trees, and also among wheat, and in meadows. It is very certain, that these insects are fond of ash-leaves, insomuch that they will sometimes strip one of these trees quite bare. Some affirm that these flies delight in sweet smelling herbs; and it is very certain, that they are fond of honey-suckles, lilac, and wild-cherry shrubs; but some that have sought after them declare they never could find them on elder-trees, nut-trees, and among wheat. We are told that the country people expect the return of these insects every seven years. It is very certain, that such a number of these insects have been seen together in the air, that they appeared like swarms of bees; and that they have so disagreeable a smell, that it may be perceived a great way off, especially about sun-set, though they are not seen at that time. This bad smell is a guide for those who make it their business to catch them. When they are caught they dry them, after which they are so light, that fifty will hardly weigh a drachm. Those that gather them tie them in a bag, or a piece of linen cloth, that has been well worn, and then they kill them with the vapours of hot vinegar, after which they dry them in the sun, and keep them in boxes. These flies, thus dried, being chemically analysed, yield a great deal of volatile caustic salt, mixed with a little oil, phlegm, and earth. Cantharides are penetrating, corrosive, and, applied to the skin, raise blisters, from whence proceeds a great deal of serosity. They are made use of both inwardly and outwardly. However, it is somewhat strange that the effects of these flies should fall principally upon the urinary passages; for though some authors have endeavoured to account for this, we are still in the dark, for all they have said amounts to no more than that they affect these parts in a manner which may be very learnedly described, but very obscurely comprehended.

An insect of great, though perhaps not equal use in medicine, is that which is known by the name of the Kermes; it is produced in the excrescence of an oak, called the berry-bearing ilex, and appears at first wrapped up in a membranaceous bladder, of the size of a pea, smooth and shining, of a brownish-red colour, and covered with a very fine ash-coloured powder. This bag teems with a number of reddish eggs or insects, which being rubbed with the fingers pour out a crimson liquor. It is only met with in warm countries in the months of May and June. In the month of April this insect becomes of the size and shape of a pea, and its eggs some time after burst from the womb, and soon turning worms, run about the branches and leaves of the tree. They are of two sexes, and the females have been hitherto described; but the males are very distinct from the former, and are a sort of small flies like gnats, with six feet, of which the four forward are short, and the two backward long, divided into four joints and armed with three crooked nails. There are two feelers on the head, a line and a half long, which are movable, streaked, and articulated. The tail, at the back part of the body, is half a line long, and forked. The whole body is covered with two transparent wings, and they leap about in the manner of fleas. The harvest of the kermes is greater or less in proportion to the severity of the winter, and the women gather them before sun-rising, tearing them off with their nails, for fear there should be any loss from the hatching of the insects. They sprinkle them with vinegar, and lay them in the sun to dry, where they acquire a red colour.

An insect, perhaps, still more useful than either of the former, is the Cochineal, which has been variously described by authors; some have supposed it a vegetable excrescence from the tree upon which it is found; some have described it as a louse; some, as a bug; and some, as a beetle. As they appear in our shops when brought from America, they are of an irregular shape, convex on one side, and a little concave on the other; but are both marked with transverse streaks or wrinkles. They are of a scarlet colour within, and without of a blackish red, and sometimes of a white, reddish, or ash colour, which are accounted the best, and are brought us from Mexico. The cochineal insect is of an oval form, of the size of a small pea, with six feet, and a snout or trunk. It brings forth its

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"love-illumined form," however obscure the place of her abode. It has been objected, however, to this explanation, that—since both larva and pupa, as De Geer observed, and the males shine as well as the females—the meeting of the sexes can scarcely be the object of their luminous provision. But this difficulty appears to me easily surmounted. As the light proceeds from a peculiarly organized substance, which probably must in part be elaborated in the larva and pupa states, there seems nothing inconsistent in the fact of *some* light being then emitted, with the supposition of its being destined solely for use in the perfect state: and the circumstance of the male having the same luminous property, no more proves that the superior brilliancy of the female is not intended for conducting him to her, than the existence of nipples and sometimes of milk in man, proves that the breast of woman is not meant for the support of her offspring. We often see, without being able to account for the fact, except on Sir E. Home's idea, that the sex of the ovum is undetermined, traces of an organization in one sex indisputably intended for the sole use of the other.—*Introduction to Entomology, by Kirby and Spence.*

young alive, and is nourished by sucking the juice of the plant. Its body consists of several rings, and when it is once fixed on the plant, it continues immovable, being subject to no change. Some pretend there are two sorts, the one domestic, which is best; and the other wild, that is of a vivid colour; however, they appear to be the same, only with this difference, that the wild feeds upon uncultivated trees, without any assistance, whereas the domestic is carefully, at a stated season, removed to cultivated trees, where it feeds upon a purer juice. Those who take care of these insects, place them on the prickly pear-plant in a certain order, and are very industrious in defending them from other insects; for if any other kind come among them, they take care to brush them off with foxes' tails. Towards the end of the year, when the rains and cold weather are coming on, which are fatal to these insects, they take off the leaves or branches covered with cochineal, that have not attained their utmost degree of perfection, and keep them in their houses till winter is past. These leaves are very thick and juicy, and supply them with sufficient nourishment, while they remain within doors. When the milder weather returns, and these animals are about to exclude their young, the natives make them nests, like those of birds, but less of tree moss, or soft hay, or the down of cocoa-nuts, placing twelve in every nest. These they fix on the thorns of the prickly-pear plant, and in three or four days' time they bring forth their young, which leave their nests in a few days, and creep upon the branches of the plant, till they find a proper place to rest in, and take in their nourishment; and until the females are fecundated by the males, which, as in the former tribe, differ very widely from the females, being winged insects, whereas the others only creep, and are at most stationary. When they are impregnated, they produce a new offspring, so that the propagator has a new harvest thrice a-year. When the native Americans have gathered the cochineal, they put them into holes in the ground, where they kill them with boiling water, and afterwards dry them in the sun, or in an oven, or lay them upon hot plates. From the various methods of killing them, arise the different colours which they appear in when brought to us. While they are living they seem to be sprinkled over with a white powder, which they lose as soon as the boiling water is poured upon them. Those that are dried upon hot plates are the blackest. What we call the cochineal are only the females, for the males are a sort of fly, as already observed in the kermes. They are used both for dying and medicine, and are said to have much the same virtue as the kermes, though they are now seldom used alone, but are mixed with other things for the sake of the colour.[1]

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[1] To the beetle kind also belong those animals which cause such alarm to the superstitious by their ticking noise, which is vulgarly called the death-watch. Various species of this insect are to be found in Britain.

The *Death-watch* or *Ptinus*, is a dusky or somewhat hairy insect, with irregular brownish spots, about a quarter of an inch in length. Notwithstanding its smallness, this creature is often the cause of serious alarm among the lower classes of people, from the noise that it makes at a certain time of the year, resembling the ticking of a watch. From this it has its name; for, whenever this faculty is exerted, it is esteemed portentive of death to some one of the family in the house where it is heard. It is chiefly in the advanced state of spring that this insect commences its noise, which is no more than a call or signal by which they are mutually attracted to each other; and it may be considered as analogous to the call of birds. This noise does not arise from the voice, but from the insect's beating on any hard substance with the shield or fore-part of the head. The general number of successive distinct strokes is from seven to nine, or eleven. These are given in pretty quick succession, and are repeated at uncertain intervals; and in old houses, where the insects are numerous, they may be heard, if the weather be warm, every hour in the day. The noise exactly resembles that made by beating with the nail upon a table. The insect being difficult to discover, from its obscure grayish brown colour, nearly resembling that of decayed wood, it is not always easy to say from what exactly the sound proceeds.

Mr Stackhouse observed carefully the manner of its beating. He says the insect raises itself on its hinder legs, and with the body somewhat inclined, beats its head with great force and agility against the place on which it stands. One of them, on a sedge-bottomed chair, exerted so much force, that its strokes were impressed and visible in the exterior coat of the sedge, for a space equal to that of a silver penny. Mr Stackhouse took this insect and put it into a box. On the following day he opened the box, and set it in the sun. It seemed very brisk, and crept about with great activity on the bits of sedge and rotten wood, till at last getting to the end of the pieces, it extended its wings, and was about to take flight; he shut down the lid, when it withdrew them, and remained quiet. He kept it by him about a fortnight.

Strange as it may appear, this little animal is capable of being tamed. Dr Derham kept a male and female together in a box for about three weeks; and by imitating their noise, (beating with his nail, or the point of a pen, on a table or board,) he made them beat whenever he pleased, and they would not only answer very readily, but even continued their beatings as long as required. At the end of this time one of them died, soon after which the other gnawed its way out and escaped.

The *Death-watch Termes*.—This insect, which is sometime mistaken for the ptinus just mentioned, is of a very different tribe, and about a tenth of an inch long. At first sight it has greatly the appearance of a louse: its mouth, however, with a glass, is seen to be reddish, and its eyes are yellow. The antennæ are sharply pointed, and somewhat long. It is sometimes, though very rarely, observed to have wings.

This insect is usually found in old wood, decayed furniture, museums, and neglected books; and both the male and female have the power of making a ticking noise, not unlike that of a watch, to attract each other. The female lays her eggs in dry and dusty places, where they are likely to meet with the least disturbance: these are exceedingly small, and are not unlike the nits or eggs of lice. When they are disturbed, they are

I shall end this account of the beetle tribe with the history of an animal which cannot properly be ranked under this species, and yet cannot be more methodically ranged under any other. This is the insect that forms and resides in the gall-nut, the spoils of which are converted to such useful purposes. The gall-insects are bred in a sort of bodies adhering to a kind of oak in Asia, which differ with regard to their colour, size, roughness, smoothness, and shape, and which we call galls. They are not fruit, as some have imagined, but preternatural tumours, owing to the wounds given to the buds, leaves, and twigs of the tree, by a kind of insects that lay their eggs within them. This animal is furnished with an implement, by which the female penetrates into the bark of the tree, or into that spot which just begins to bud, and there sheds a drop of corrosive fluid into the cavity. Having thus formed a receptacle for her eggs, she deposits them in the place, and dies soon after. The heart of the bud being thus wounded, the circulation of the nutritive juice is interrupted, and the fermentation thereof, with the poison injected by the fly, burns the parts adjacent, and then alters the natural colour of the plant. The juice or sap, turned back from its natural course, extravasates, and flows round the egg. After which it swells and dilates by the assistance of some bubbles of air, which get admission through the pores of the bark, and which run in the vessels with the sap. The external coat of this excrescence is dried by the air, and grows into a figure, which bears some resemblance to the bow of an arch, or the roundness of a kernel. This little ball receives its nutriment, growth, and vegetation, as the other parts of the tree, by slow degrees, and is what we call the *gall-nut*. The worm that is hatched under this specious vault, finds in the substance of the ball, which is as yet very tender, a substance suitable to its nature; gnaws and digests it till the time comes for its transformation to a nymph, and from that state of existence changes into a fly. After this, the insect, perceiving itself duly provided with all things requisite, disengages itself soon from its confinement, and takes its flight into the open air. The case, however, is not similar with respect to the gall-nut that grows in autumn. The cold weather frequently comes on before the worm is transformed into a fly, or before the fly can pierce through its inclosure. The nut falls with the leaves, and although you may imagine that the fly which lies within is lost, yet in reality it is not so; on the contrary, its being covered up so close, is the means of its preservation. Thus it spends the winter in a warm house, where every crack and cranny of the nut is well stopped up; and lies buried, as it were, under a heap of leaves, which preserves it from the injuries of the weather. This apartment, however, though so commodious a retreat in the winter, is a perfect prison in the spring. The fly, roused out of its lethargy by the first heats, breaks its way through, and ranges where it pleases. A very small aperture is sufficient, since at this time the fly is but a diminutive creature. Besides, the ringlets whereof its body is composed, dilate, and become pliant in the passage.

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very shy in making their tickings; but if they can be viewed without being alarmed by noise, or moving the place where they are, they will not only beat freely, but even answer any person's beating with his nail. At every stroke their body shakes, or seems affected as by a sudden jerk; and these jerks succeed each other so quickly, that it requires great steadiness to perceive with the naked eye that the body has any motion. They are scarcely ever heard to beat before July, and never later than the sixteenth of August. It appears strange that so small an insect should be able to make a noise so loud as is frequently to be heard from this; sometimes equal to that of the strongest beating watch. Dr Derham, who examined and first described this species, says, he had often heard the noise, and in pursuing it found nothing but these insects, which he supposed incapable of producing it; but one day, by finding that the noise proceeded from a piece of paper loosely folded, and lying in a good light in his study window, he viewed it through, and with a microscope observed, to his great astonishment, one of them in the very act of beating. In some years they are more numerous than in others, and their ticking is of course more frequently heard. We are informed by the above naturalist, that, during the month of July, in one particular summer, they scarcely ever ceased, either in the day or night.

CHAP. VII.

OF THE GNAT TIPULA.

THERE are two insects which entirely resemble each other in their form, and yet widely differ in their habits, manners, and propagation. Those who have seen the tipula, or long-legs, and the larger kind of gnat, have most probably mistaken the one for the other; they have often accused the tipula, a harmless insect, of depredations made by the gnat, and the innocent have suffered for the guilty; indeed the differences in their form are so very minute, that it often requires the assistance of a microscope to distinguish the one from the other: they are both mounted on long legs, both furnished with two wings and a slender body; their heads are large, and they seem to be hump-backed; the chief and only difference, therefore, is, that the tipula wants a trunk, while the gnat has a large one, which it often exerts to very mischievous purposes. The tipula is a harmless peaceful insect, that offers injury to nothing; the gnat is sanguinary and predaceous, ever seeking out for a

place in which to bury its trunk, and pumping up the blood from the animal in large quantities.

The gnat proceeds from a little worm, which is usually seen at the bottom of standing waters. The manner in which the insect lays its eggs is particularly curious: after having laid the proper number on the surface of the water, it surrounds them with a kind of unctuous matter, which prevents them from sinking, but at the same time fastens them with a thread to the bottom, to prevent their floating away, at the mercy of every breeze, from a place, the warmth of which is proper for their production, to any other, where the water may be too cold, or the animals' enemies too numerous. Thus the insects, in their egg state resemble a buoy, which is fixed by an anchor. As they come to maturity they sink deeper; and at last when they leave the egg as worms, they creep to the bottom.[1] They now make themselves lodgments of cements, which they fasten to some solid body at the very bottom of the water, unless by accident they meet with a piece of chalk, which being of a soft and pliant nature, gives them an opportunity of sinking a retreat for themselves, where nothing but the claws of a cray-fish can possibly molest them. The worm afterwards changes its form. It appears with a large head, and a tail invested with hair, and moistened with an oleaginous liquor, which she makes use of as a cork to sustain her head in the air, and her tail in the water, and to transport her from one place to another. When the oil with which her tail is moistened, begins to grow dry, she discharges out of her mouth an unctuous humour, which she sheds all over her tail, by virtue whereof she is enabled to transport herself where she pleases, without being either wet or anywise incommoded by the water. The gnat, in her second state, is, properly speaking, in her form a nymph, which is an introduction or entrance into a new life. In the first place, she divests herself of her second skin; in the next, she resigns her eyes, her antennæ, and her tail; in short, she actually seems to expire. However, from the spoils of the amphibious animal, a little winged insect cuts the air, whose every part is active to the last degree, and whose whole structure is the just object of our admiration. Its little head is adorned with a plume of feathers, and its whole body invested with scales and hair, to secure it from any wet or dust. She makes trial of the activity of her wings, by rubbing them either against her body, or her broad side-bags, which keep her in an equilibrium. The furbelow, or little border of fine feathers, which graces her wings, is very curious, and strikes the eye in the most agreeable manner. There is nothing, however, of greater importance to the gnat than her trunk, and that weak implement may justly be deemed one of nature's master-pieces. It is so very small, that the extremity of it can scarcely be discerned through the best microscope that can be procured. That part which is at first obvious to the eye, is nothing but a long scaly sheath under the throat. At near the distance of two-thirds of it, there is an aperture, through which the insect darts out four stings, and afterwards retracts them. One of which, however sharp and active it may be, is no more than the case in which the other three lie concealed, and run in a long groove. The sides of these stings are sharpened like two-edged swords; they are likewise barbed, and have a vast number of cutting teeth towards the point, which turns up like a hook, and is fine beyond expression. When all these darts are stuck into the flesh of animals, sometimes one after another, and sometimes all at once, the blood and humours of the adjacent parts must unavoidably be extravasated; upon which a tumour must consequently ensue, the little orifice whereof is closed up by the compression of the external air. When the gnat, by the point of her case,

[1] We are hardly acquainted with any other than the aërial life of the gnat, yet its aquatic life is also very interesting. It is upon or under the water that the gnat is in its stages of egg, *larva*, and nymph, that is, during almost the whole of its existence, and that an existence which in no way annoys man.

The eggs of this insect have the lengthened form of an olive; their own weight is sufficient to sink them, but 250 or 300 united, and stuck together with a natural glue in the shape of a boat, float on the surface of the water till the *larvæ* come out of them. The part of this agglomeration which touches the water is convex, its upper part concave; and this skiff is so well balanced, that the most furious tempest would not upset it. The learned Kirby made the experiment himself, by placing a dozen of these little boats in a glass half full of water; he then violently troubled the water in the glass, by pouring in water from a pitcher, without being able to succeed in sinking these little boats, of which not one contained a single drop of water when he had ended his experiments.

The manner in which the gnat constructs this floating apparatus is very singular. This insect, as every one knows, is provided with six legs; it places its four front-feet on a dead leaf, a twig, or any other floating substance; its body thus remains horizontally on the surface of the water, with the exception of the last segment of its *abdomen*, which it keeps a little raised; it then extends its long hind legs, and crosses them in the shape of the letter X, and thus forms a support for the first eggs it is about to lay. Each egg, when laid, is enclosed in a kind of glue; the female supports the first in a vertical position till the second egg is placed by its side, and glued to it; the third forms a triangle, and so on. When the boat is completed, the gnat leaves it on the water, and flies away, to end, in a short time, that existence of which it has fulfilled the most important task.



Boat of gnat's eggs.

which she makes use of as a tongue, has tasted any fruit, flesh, or juice, that she has found out; if it be a fluid, she sucks it up, without playing her darts into it; but in case she finds the least obstruction by any flesh whatever, she exerts her strength, and pierces through it, if possibly she can. After this she draws back her stings into their sheath, which she applies to the wound in order to extract, as through a reed, the juices which she finds inclosed. This is the implement with which the gnat performs her work in the summer, for during the winter she has no manner of occasion for it. Then she ceases to eat, and spends all that tedious season either in quarries or in caverns, which she abandons at the return of summer, and flies about in search after some commodious ford, or standing water, where she may produce her progeny, which would be soon washed away and lost, by the too rapid motion of any running stream. The little brood are sometimes so numerous, that the very water is tinged according to the colour of the species, as green, if they be green, and of a sanguine hue, if they be red.

These are circumstances sufficiently extraordinary in the life of this little animal; but it offers something still more curious in the method of its propagation. However similar insects of the gnat kind are in their appearance, yet they differ widely from each other in the manner in which they are brought forth, for some are oviparous, and are produced from eggs: some are viviparous, and come forth in their most perfect form; some are males, and unite with the female; some are females, requiring the impregnation of the male; some are of neither sex, yet still produce young, without any copulation whatsoever. This is one of the strangest discoveries in all natural history! A gnat separated from the rest of its kind, and inclosed in a glass vessel, with air sufficient to keep it alive, shall produce young, which also, when separated from each other, shall be the parents of a numerous progeny. Thus, down for five or six generations, do these extraordinary animals propagate without the use of copulation, without any congress between the male and the female, but in the manner of vegetables, the young bursting from the body of their parents, without any previous impregnation. At the sixth generation, however, their propagation stops; the gnat no longer produces its like, from itself alone, but it requires the access of the male to give it another succession of fecundity.

The gnat of Europe gives but little uneasiness; it is sometimes heard to hum about our beds at night, and keeps off the approaches of sleep by the apprehension it causes; but it is very different in the ill-peopled regions of America, where the waters stagnate, and the climate is warm, and where they are produced in multitudes beyond expression. The whole air is there filled with clouds of those famished insects, and they are found of all sizes, from six inches long to a minuteness that even requires the microscope to have a distinct perception of them.[1] The warmth of the mid-day sun is too powerful for their constitutions; but when the evening approaches, neither art nor

[1] Under the common names of *gnat* and *musquito*, a numerous family are confounded, as if there were only one or two species; whereas Mr Stephen has enumerated twenty-two species of the genera *Culex* and *Anopheles*, found in Britain alone; and hence, it is probable, the foreign musquitoes are also of several species, though to common observers they do not appear to differ from the common gnat.

The *Musquito-fly* is very common in the woody and marshy parts of all hot climates. It also abounds, during their short summer, throughout Lapland, Norway, and Finland, and other countries equally near the pole. The female bites, and sucks the blood in such a severe manner, as to swell and blister the skin very severely, and sometimes leave obstinate sores. These insects are found in such swarms, in the woods, that whoever enters them is sure to have his face covered, and he is scarcely able to see his way before him. A swelling and disagreeable itch instantly follows the puncture, and these are succeeded by small white ulcers; so that the face of a person coming from the country is scarcely to be recognised, and it appears full of blotches. Even gloves are not always found a protection against these troublesome insects, as they often pass their stings through the seams. It is the female only that bites; the buzzing, however, of both males and females is so very loud, as to be alone sufficient to disturb the rest of persons at night.

The *Ox Gad-fly* has brown unspotted wings; and the abdomen is marked with a black band in the middle, and has dusky yellow hairs at the tip. The front is white, and covered with down; and the thorax is yellowish before, black in the middle, and cinereous behind. The female differs from the male in having a black style at the end of the abdomen. This insect deposits its eggs in the back of the ox, and the larvæ live beneath the skin, between this and the cellular membrane. Its sac or abscess is somewhat larger than the insect, and by narrowing upwards, it opens externally to the air by a small aperture. The Ox Gad-fly is the largest of the European species, and is very beautiful: it is, however, the terror of cattle, as it inflicts great pain when depositing its eggs.

The *Horse Gad-fly* is distinguished from the rest of its tribe by having a black band in the middle and two dots at the tip of its whitish wings. The abdomen is yellow brown, with black spots at the divisions of the segments. The female is more brown than the male, and has her abdomen elongated with a cleft terminal style. The larvæ are those odd-looking grubs which are commonly found in the stomachs of horses, and sometimes, though much less frequently, in the intestines. Here they hang in clusters of from half a dozen to more than a hundred, adhering to the inner membrane of the stomach, by means of two small hooks or tentaculæ at their heads, whose points turn outward. When they are removed from the stomach, they will attach themselves to any loose membrane, even to the skin of the hand. To effect this they draw back their hooks, which have a joint near their base, almost entirely within their skin; till the two points come close to each other; then, keeping them parallel, they pierce through the membrane, and immediately afterwards expand in a lateral direction; and by these means they become perfectly fixed.

flight can shield the wretched inhabitants from their attacks; though millions are destroyed, still millions more succeed, and produce unceasing torment. The native Indians, who anoint their bodies with oil, and who have from their infancy been used to their depredations, find them much less inconvenient than those who are newly arrived from Europe; they sleep in their cottages covered all over with thousands of the gnat kind upon their bodies, and yet do not seem to have their slumbers disturbed by their cruel devourers. If a candle happens to be lighted in one of those places, a cloud of insects at once light upon the flame and extinguish it: they are therefore obliged to keep their candles in glass lanterns; a miserable expedient to prevent an unceasing calamity!

HISTORY OF ZOOPHYTES.

BOOK V.

OF THE ZOOPHYTES.

CHAP. I.

OF ZOOPHYTES IN GENERAL.

We now come to the last link in the chain of animated nature, to a class of beings so confined in their powers, and so defective in their formation, that some historians have been at a loss whether to consider them as a superior rank of vegetables, or the humblest order of the animated tribe. In order, therefore, to give them a denomination agreeable to their existence, they have been called Zoophytes, a name implying vegetable nature endued with animal life; and, indeed, in some the marks of the animal are so few, that it is difficult to give their place in nature with precision, or to tell whether it is a plant or an insect that is the object of our consideration.

Should it be asked what it is that constitutes the difference between animal and vegetable life; what it is that lays the line that separates those two great kingdoms from each other, it would be difficult, perhaps we should find it impossible, to return an answer. The power of motion cannot form this distinction, since some vegetables are possessed of motion, and many animals are totally without it. The sensitive plant has obviously a greater variety of motions than the oyster or the pholas. The animal that fills the acorn-shell is immovable, and can only close its lid to defend itself from external injury, while the flower which goes by the name of the fly-trap, seems to close upon the flies that light upon it, and that attempt to rifle it of its honey. The animal in this instance seems to have scarce a power of self-defence; the vegetable not only guards its possessions, but seizes upon the robber that would venture to invade them. In like manner, the methods of propagation give no superiority to the lower rank of animals. On the contrary, vegetables are frequently produced more conformably to the higher ranks of the creation, and though some plants are produced by cuttings from others, yet the general manner of propagation is from seeds, laid in the womb of the earth, where they are hatched into the similitude of the parent plant or flower. But a most numerous tribe of animals have lately been discovered, which are propagated by cuttings, and this in so extraordinary a manner, that, though the original insect be divided into a thousand parts, each, however small, shall be formed into an animal, entirely resembling that which was at first divided; in this respect, therefore, certain races of animals seem to fall beneath vegetables, by their more imperfect propagation.[1]

[1] There is much less of acumen and solidity in these remarks of our author than might have been expected. That there is, to a certain extent, community of feature and character between vegetable bodies and the zoophyte tribes, is at once admitted, for the very name of the latter implies the junction of animal and vegetable characteristics in the same individual. But there is never wanting a broad and striking distinction between the zoophyte and the mere vegetable. We may indeed produce plants possessing motion, and seemingly indued with sensibility, but attentive examination and reflection uniformly convince us that such motion and apparent sensitiveness are mere mechanical properties, in nowise the result of a voluntary principle. We may, again, instance zoophytes in which, at first view, the vegetable character is so predominant, and the animal powers so limited, that they scarcely appear to fall within the lowest orders of animated existences. On close examination, however, we discover that their motions are undoubtedly influenced by volition, or will; and that they have instincts approximating to those of more perfect animals. We readily admit that it requires long and patient observation to distinguish, in many cases, between vegetables and zoophytes; but we believe no instance could be brought forward in which the question of animality might not be determined by the presence or absence of a *will*.

What, therefore, is the distinction between them?—or are the orders so intimately blended as that it is impossible to mark the boundaries of each? To me it would seem, that all animals are possessed of one power, of which vegetables are totally deficient; I mean, either the actual ability, or an awkward attempt at self-preservation. However vegetables may seem possessed of this important quality, yet it is with them but a mechanical impulse, resembling the raising one end of the lever when you depress the other; the sensitive plant contracts and hangs its leaves, indeed, when touched, but this motion no way contributes to its safety: the fly-trap flower acts entirely in the same manner; and though it seems to seize the little animal that comes to annoy it, yet, in reality, only closes mechanically upon it, and this inclosure neither contributes to its preservation nor its defence. But it is very different with insects, even of the lowest order; the earth-worm not only contracts, but hides itself in the earth, and escapes with some share of swiftness from its pursuers. The polypus hides its horns; the star-fish contracts its arms upon the appearance even of distant dangers; they not only hunt for their food, but provide for their safety; and however imperfectly they may be formed, yet still they are in reality placed many degrees above the highest vegetable of the earth, and are possessed of many animal functions, as well as those that are more elaborately formed.

But though these be superior to plants, they are far beneath their animated fellows of existence. In the class of zoophytes, we may place all those animals which may be propagated by cuttings; or in other words, which, if divided into two or more parts, each part in time becomes a separate and perfect animal; the head shoots forth a tail, and, on the contrary, the tail produces a head; some of these will bear dividing but into two parts, such as the earth-worm; some may be divided into more than two, and of this kind are many of the star-fish; others still may be cut into a thousand parts, each becoming a perfect animal; they may be turned inside out, like the finger of a glove; they may be moulded into all manner of shapes, yet still their vivacious principle remains, still every single part becomes perfect in its kind, and, after a few days' existence, exhibits all the arts and industry of its contemptible parent! We shall, therefore, divide zoophytes according to their several degrees of perfection, namely, into worms, star-fish, and polypi; contenting ourselves with a short review of those nauseous and despicable creatures, that excite our curiosity chiefly by their imperfections; it must not be concealed, however, that much has of late been written on this part of natural history. A new mode of animal production, could not fail of exciting not only the curiosity, but the astonishment of every philosopher; many found their favourite systems totally overthrown by the discovery; and it was not without a wordy struggle, that they gave up what had formerly been their pleasure and their pride. At last, however, conviction became too strong for argument; and a question, which owed its general spread rather to its novelty than to its importance, was given up in favour of the new discovery.

CHAP. II.

OF WORMS.[1]

The first in the class of zoophytes, are animals of the worm kind, which, being entirely

[1] "The characters of insects are so distinct and intelligible, those of worms, on the contrary, so vague, and so far from positive, that the shortest way of defining the latter might perhaps be as animals with white blood, not insects; differing from them by the deficiency as well of antennæ as of articulated organs of motion. They have, for the most part, soft glutinous bodies, a few only being covered with hair, as the aphrodites, or with a calcareous shell, as the sea-hedgehog. Many amphitrites construct an artificial shell of grains of sand, &c; whilst many other animals of this class, viz. the testacea and certain polypes, inhabit a solid house resembling porcelain or stone, congenital, and serving the purposes of residence and defence; in some cases it is carried about by the animal, in others is firmly attached to one spot. No animal of this class has wings, for the springing of the cuttle-fish out of the water is not to be called flying; neither has it any true legs for the support of the body, or for motion. Earth-worms, sea-hedgehogs, sea-anemones, &c. have, however, particular organs, which in some degree answer similar purposes. In many instances too, the deficiency of external organs of motion in worms, is supplied by the power which they possess of alternately elongating and shortening themselves. Instead of *antennæ*, many worms have *tentacula*, soft, fleshy cords or fibres, attached to the head, flexible, *not articulated*, in some cases of considerable length, and serving a variety of purposes; sometimes for touching, at others for taking their prey, and so forth. Of the senses of these animals and the organs devoted to them, still less that is positive can be said than of those of insects. Some have undoubtedly true eyes, as the sepiæ, &c. and others, without having eyes, possess a most acute feeling of sight. In their internal structure, most worms differ as much from insects as these do from red-blooded animals.

"This class also differs from insects in this, that no animal belonging to it undergoes a true metamorphosis, which is so generally the case amongst them. The abode of these animals is generally in water; and by far the greater part of them in the ocean. Some live under ground; others exclusively in the living bodies of other animals, as the intestinal worms, seminal animalcules, &c. Their remarkable powers of reproduction serve to insure the preservation of many animals of this class, and some, as the animalcula of paste, the wheel-animal, &c., possess a kind of revivescence, which appears to

destitute of feet, trail themselves along upon the ground, and find themselves a retreat under the earth, or in the water. As these, like serpents, have a creeping motion, so both, in general, go under the common appellation of reptiles: a lothesome, noxious, malignant tribe, to which man by nature, as well as by religion, has the strongest antipathy. But though worms, as well as serpents, are mostly without feet, and have been doomed to creep along the earth on their bellies, yet their motions are very different. The serpent, as has been said before, having a back-bone, which it is incapable of contracting, bends its body into the form of a bow, and then shoots forward from the tail; but it is very different with the worm, which has a power of contracting or lengthening itself at will. There is a spiral muscle, that runs round its whole body, from the head to the tail, somewhat resembling a wire wound round a walking-cane, which when slipped off, and one end extended and held fast, will bring the other nearer to it; in this manner the earth-worm, having shot out, or extended its body, takes hold by the slime of the forepart of its body, and so contracts and brings forward the hinder part; in this manner it moves onward, not without great efforts; but the occasions for its progressive motions are few.

As it is designed for living under the earth, and leading a life of obscurity, so it seems tolerably adapted to its situation. Its body is armed with small stiff sharp burrs or prickles, which it can erect or depress at pleasure; under the skin there lies a slimy juice, to be ejected as occasion requires, at certain perforations, between the rings of the muscles, to lubricate its body, and facilitate its passage into the earth. Like most other insects it has breathing holes along the back, adjoining each ring; but is without bones, without eyes, without ears, and properly without feet. It has a mouth, and also an alimentary canal, which runs along to the very point of the tail. In some worms, however, particularly such as are found in the bodies of animals, this canal opens towards the middle of the belly, at some distance from the tail. The intestines of the earth worm are always found filled with a very fine earth, which seems to be the only nourishment these animals are capable of receiving.

The animal is entirely without a brain, but near the head is placed the heart, which is seen to beat with a very distinct motion, and round it are the spermatic vessels, forming a number of little globules, containing a milky fluid, which have an opening into the belly, not far from the head; they are also often found to contain a number of eggs, which are laid in the earth, and are hatched in twelve or fourteen days into life, by the genial warmth of their situation; like snails, all these animals unite in themselves both sexes at once; the rep-

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render them, in some degree, indestructible. The generality of the intestinal worms of animals, and, the sepiæ excepted, by far the greater number of worms, are true hermaphrodites, of which each individual is capable of propagating the species. The mode of copulation in many animals of this class is also very peculiar, as in the common garden and tree snails, which at that time are provided with a remarkable little dart, composed of calcareous matter, and having the shape of a four-edged lance. This dart is fixed loosely in an opening in the neck, and when the two snails meet, each presses its dart into the breast of the other, this mutual excitement being precursory to actual copulation.

"The vast numbers of marine animals in this class, particularly the testacea and corals, are of extreme importance to the general economy of nature, inasmuch as they in the ocean, in the same manner with insects upon the earth, incessantly destroy, consume, and, as it were, metamorphose an infinite variety of noxious or superfluous substances. To man, they are in so far serviceable, that many, particularly of the mollusca and testacea, are eatable; some, as for instance, the venus *mercenaria*, and mytilus *bidens*, serving as a principal article of diet to many navigators and inhabitants of sea coasts. The *purple dye* was procured from certain shell-fish, more formerly than at present. Ink and Indian ink are procured from the peculiar fluid of the cuttle-fish. The beard of certain species of pinna affords a kind of brown silk, which may be manufactured. Many kinds of shells contain pearls. Red coral is an important article of trade, particularly in the East Indies. Several kinds of shells, either entire or divided, pass current as money among some remote nations. From portions of similar shells, the Iroquois and other North American people, made their *wampum*, which serves the purpose of records.

Many savage people use muscle and snail shells for drinking vessels, spoons, &c. The South sea islanders make from them ingenious hooks and a variety of other fishing-tackle. The North-western Americans point their harpoons with angular pieces of muscle shells. In regard to works of art: mother of pearl and many muscle and snail shells are cut like onyx into camoes. The cuttle-fish bone is employed by artists and workmen. Sponge serves a variety of domestic purposes. Madrepore is employed for paving and building on the coasts of the Red sea. Numerous testacea (the shells) and corals are burnt for lime. Some large thin shells are used as glass in the south of China, and in India. The shells of testacea are among the most common ornaments of savage nations. In the great collection of objects from the South seas presented to the academical Museum of Gottingen, is, among other articles, a necklace of neat shells, carefully polished, bored, and ingeniously twisted together with tendons, all the work of a race of men commonly considered as the most wretched outcasts of the human species, viz. the natives of the Sierra del Fuego. Lastly, the leech is of great importance in the treatment of certain diseases. (See an account of the leech in the present volume, page 467.)

"Among the noxious animals of this class, are, in particular, the worms of the human body, which either live in the intestines, as the ascurides fæniæ, &c., or as the Guinea-worm, immediately under the skin. Others of a similar character, are the flukes found in sheep, the hyditids of swine, and the worms found in many quadrupeds and fishes, producing disease. Earth-worms and snails are injurious to plants. Certain species of the genera teredo and pholas perforate ships and dams."—*Blumenbach.*

tile that impregnates, being impregnated in turn: few that walk out, but must have observed them, with their heads laid against each other, and so strongly attached, that they suffer themselves to be trode upon.

When the eggs are laid in the earth, which, in about fourteen days, as has been said, are hatched into maturity, the young ones come forth very small, but perfectly formed, and suffer no change during their existence; how long their life continues is not well known, but it certainly holds for more than two or three seasons. During the winter, they bury themselves deeper in the earth, and seem in some measure to share the general torpidity of the insect tribe. In spring, they revive with the rest of nature, and on those occasions, a moist or dewy evening brings them forth from their retreats, for the universal purpose of continuing their kind. They chiefly live in a light, rich, and fertile soil, moistened by dews or accidental showers, but avoid those places where the water is apt to lie on the surface of the earth, or where the clay is too stiff for their easy progression under ground.

Helpless as they are formed, yet they seem very vigilant in avoiding those animals that chiefly make them their prey; in particular, the mole, who feeds entirely upon them beneath the surface, and who seldom ventures, from the dimness of its sight, into the open air; him they avoid, by darting up from the earth the instant they feel the ground move; and fishermen, who are well acquainted with this, take them in what numbers they choose, by stirring the earth where they expect to find them. They are also driven from their retreats under ground, by pouring bitter or acrid water thereon, such as that water in which green walnuts have been steeped, or a ley made of pot-ashes.

Such is the general outline of the history of these reptiles, which, as it should seem, degrades them no way beneath the rank of other animals of the insect creation: but now we come to a part of their history which proves the imperfection of their organs, from the easiness with which these little machines may be damaged and repaired again. It is well known in mechanics, that the finest and most complicated instruments are the most easily put out of order, and the most difficultly set right; the same also obtains in the animal machine. Man, the most complicated machine of all others, whose nerves are more numerous, and powers of action more various, is most easily destroyed; he is seen to die under wounds which a quadruped or a bird could easily survive; and as we descend gradually to the lower ranks, the ruder the composition, the more difficult it is to disarrange it. Some animals live without their limbs, and often are seen to reproduce them; some are seen to live without their brain for many weeks together; caterpillars continue to increase and grow large, though all their nobler organs are entirely destroyed within; some animals continue to exist, though cut in two, their nobler parts preserving life, while the others perish that were cut away; but the earth-worm, and all the zoophyte tribe, continue to live in separate parts, and one animal, by the means of cutting, is divided into two distinct existences, sometimes into a thousand!

There is no phenomenon in all natural history more astonishing than this, that man at pleasure should have a kind of creative power, and out of one life make two, each completely formed, with all its apparatus and functions; each with its perceptions, and powers of motion and self-preservation; each as complete in all respects as that from which it derived its existence, and equally enjoying the humble gratifications of its nature.

When Des Cartes first started the opinion, that brutes were machines, the discovery of this surprising propagation was unknown, which might, in some measure, have strengthened his fanciful theory. What is life in brutes? he might have said, or where does it reside? In some we find it so diffused, that every part seems to maintain a vivacious principle, and the same animal appears possessed of a thousand distinct irrational souls at the same time. But let us not, he would say, give so noble a name to such contemptible powers, but rank the vivifying principle in these with the sap that rises in vegetables, or the moisture that contracts a cord, or the heat that puts water into motion! Nothing, in fact, deserves the name of soul, but that which reasons, that which understands, and by knowing God, receives the mark of its currency, and is minted with the impression of its great Creator.

Such might have been the speculations of this philosopher: however, to leave theory, it will be sufficient to say, that we owe the first discovery of this power of reproduction in animals to Mr Trembley, who first observed it in the Polypus, and after him, Spalanzani and others found it taking place in the earth-worm, the sea-worm, and several other ill-formed animals of a like kind, which were susceptible of this new mode of propagation. This last philosopher has tried several experiments upon the earth-worm, many of which succeeded according to his expectation: every earth-worm, however, did not retain the vivacious principle with the same obstinacy; some, when cut in two, were entirely destroyed; others survived only in the nobler part; and while the head was living, the tail entirely perished, and a new one was seen to bourgeon

from the extremity. But what was most surprising of all, in some, particularly in the small red-headed earth-worm, both extremities survived the operation; the head produced a tail, with the anus, the intestines, the annular muscle, and the prickly beards; the tail part, on the other hand, was seen to shoot forth the nobler organs, and in less than the space of three months sent forth a head, a heart, with all the apparatus and instruments of generation. This part, as may easily be supposed, was produced much more slowly than the former, a new head taking above three or four months for its completion; a new tail being shot forth in less than as many weeks. Thus two animals, by dissection, were made out of one, each with their separate appetites, each endued with life and motion, and seemingly as perfect as that single animal from whence they derived their origin.

What was performed upon the earth-worm was found to obtain also in many of the vermicular species. The sea-worm, the white water-worm, and many of those little worms with feelers, found at the bottom of dirty ditches; in all these the nobler organs are of such little use, that if taken away, the animal does not seem to feel the want of them; it lives in all its parts, and in every part; and by a strange paradox in nature, the most useless and contemptible life is of all others the most difficult to destroy.

CHAP. III.

OF THE STAR-FISH.

The next order of zoophytes, is that of the star-fish, a numerous tribe, shapeless and deformed, assuming at different times different appearances. The same animal that now appears round like a ball, shortly after flattens as thin as a plate. All of this kind are formed of a semi-transparent gelatinous substance, covered with a thin membrane, and to an inattentive spectator often appear like a lump of inanimate jelly, floating at random upon the surface of the sea, or thrown by chance on shore at the departure of the tide. But upon a more minute inspection, they will be found possessed of life and motion; they will be found to shoot forth their arms in every direction, in order to seize upon such insects as are near, and to devour them with great rapacity. Worms, the spawn of fish, and even muscles themselves, with their hard resisting shell, have been found in the stomachs of these voracious animals; and what is very extraordinary, though the substance of their own bodies be almost as soft as water, yet they are no way injured by swallowing these shells, which are almost of a stony hardness. They increase in size as all other animals do. In summer, when the water of the sea is warmed by the heat of the sun, they float upon the surface, and in the dark they send forth a kind of shining light resembling that of phosphorus. Some have given these animals the name of sea-nettles, because they burn the hands of those that touch them, as nettles are found to do. They are often seen fastened to the rocks, and to the largest sea-shells, as if to derive their nourishment from them. If they be taken and put into spirits of wine, they will continue for many years entire: but if they be left to the influence of the air, they are, in less than four and twenty hours, melted down into limpid and offensive water.

In all of this species, none are found to possess a vent for their excrements; but the same passage by which they devour their food, serves for the ejection of their fæces. These animals, as was said, take such a variety of figures, that it is impossible to describe them under one determinate shape; but in general their bodies resemble a truncated cone, whose base is applied to the rock to which they are found usually attached. Though generally transparent, yet they are found of different colours, some inclining to green, some to red, some to white, and some to brown. In some, their colours appear diffused over the whole surface, in some they are often streaked, and in others often spotted. They are possessed of a very slow progressive motion, and in fine weather they are continually seen, stretching out and fishing for their prey. Many of them are possessed of a number of long slender filaments, in which they entangle any small animals they happen to approach, and thus draw them into their enormous stomachs, which fill the whole cavity of their bodies. The harder shells continue for some weeks undigested, but at length they undergo a kind of maceration in the stomach, and become a part of the substance of the animal itself. The indigestible parts are returned by the same aperture by which they were swallowed, and then the star-fish begins to fish for more. These also may be cut in pieces, and every part will survive the operation; each becoming a perfect animal, endued with its natural rapacity. Of this tribe, the number is various, and the description of each would be tedious and uninstructing; the manners and nature of all are nearly as described; but I will just make mention of one creature, which, though not properly belonging to this class, yet is so nearly related, that the passing it in silence would be an unpardonable omission.

Of all other animals, the cuttle-fish, though in some respects superior to this tribe, posses-

ses qualities the most extraordinary. It is about two feet long, covered with a very thin skin, and its flesh composed of a gelatinous substance, which, however, within-side, is strengthened by a strong bone, of which such great use is made by the goldsmith. It is possessed of eight arms, which it extends, and which are probably of service to it in fishing for its prey: while in life, it is capable of lengthening or contracting these at pleasure; but when dead, they contract, and lose their rigidity. They feed upon small fish, which they seize with their arms; and they are bred from eggs, which are laid upon the weeds along the sea-shore.

The cuttle-fish is found along many of the coasts of Europe, but are not easily caught, from a contrivance with which they are furnished by nature; this is a black substance, of the colour of ink, which is contained in a bladder generally on the left side of the belly, and which is ejected in the manner of an excrement from the anus. Whenever, therefore, this fish is pursued, and when it finds a difficulty of escaping, it spurts forth a great quantity of this black liquor, by which the waters are totally darkened, and then it escapes by lying close at the bottom. In this manner the creature finds its safety; and men find ample cause for admiration, from the great variety of stratagems with which creatures are endued for their peculiar preservation.

CHAP. IV.

OF THE POLYPUS.[1]

Those animals which we have described in the last chapter are variously denominated. They have been called the Star-fish, Sea-nettles, and Sea-polypi. This last name has been peculiarly ascribed to them by the ancients, because of the number of feelers or feet of

[1] Dr George Johnston, in his elegant work on British Zoophytes, recently published, (Edinburgh, 1838, 8vo), has adopted a new and seemingly excellent classification of the zoophyte division of the animal kingdom. Where a plant-like aquatic production, such as the *Sponge*, cannot be discovered to be the work of, or connected with, a polype, he excludes it from the zoophyte class, limiting that term to polypes and their polypidoms. This arrangement clearly defines the class. Of the zoophytes thus distinguished, he forms two sub-classes, radiated zoophytes, and molluscan zoophytes. The characters of these sub-classes are thus described: The radiated zoophytes have a body contractile in every part, and symmetrical; one aperture for receiving food, and expelling its refuse; and are propagated both by globules and by eggs. The molluscan zoophytes have a body non-contractile and non-symmetrical; separate apertures for the reception of food, and expulsion of refuse; and are propagated both by globules and eggs. The radiated zoophytes are so named from the star-like disposition of the calcareous matter of their polypidoms, while the molluscan zoophytes are so entitled, because their polypidoms, unlike those of the preceding class, are living portions of the polypes they contain, as is the case with the shelled molluscous animals, of which the lobster is an example. The radiated zoophytes, again, are divided into three orders, the hydroida, (so called from some affinity in their character to those of the *many-headed* hydra, a fabulous serpent), the asteroida, (from the *star-like* marks which distinguish them), and the helianthoida, (a word which expresses their likeness to certain flowers, as the anemone and marygold.) The molluscan class of zoophytes has but one order, termed the ascidoida, of which the chief distinctive characteristic is the vitality of their enclosing crusts or cases. Of all these orders, there are a number of families and species. Most of the polypi form compound animals, attached to one another by lateral appendages, or by their posterior extremity, participating in a common life, while at the same time they enjoy their individual and independent existence. Many of this tribe are supposed to be gemmiferous, or to extend the race by buds in the same manner as plants, while others propagate their species by means of eggs. In the lowest races of polypi, the distinctive characters of animal life are so slightly developed, that there is much difficulty in distinguishing them from the cryptogamic families of the vegetable kingdom. The resemblance of these animals to plants consists in this, that from the egg is formed a bulb, which shoots up into a stem, and sends off branches; there is also a root, which, however, is merely the organ of attachment, affording no nourishment to the animals. Being thus immovably fixed to a particular spot, they have no other means of providing themselves with food, but by their long tentacula, which act as arms to convey the food to the mouth; these members only are capable of voluntary motion. The vegetable structure of this class, long obtained for them the name of animal plants. Some of them, however, float about in the ocean, as the *pennatula*, or sea pens.

About the year 1699, Imperati and Gesner had remarked the animal structure of polypi or corals; and Peysonnell, in 1727, was the first who ascertained the living inhabitants of those stony and horny structures, and his discoveries have been confirmed by Trembley's treatise upon the hydræ, published in 1740; and subsequently by Reaumur, Jussieu, Donati, Ellis, Boccone, Degeer, Baster, Cavolini, Pallas, Linnæus, and Cuvier. All the animals of this class were placed by Linnæus as an order of his class *Vermes*, under the distinctive appellation of lithophytæ. The sagacity of that great naturalist enabled him to form a superstructure, upon which has been built the more improved, because better known classifications of Pallas, Bruguière, and Lamarck; whose arrangement we mean to follow, as being more comprehensive than that of Cuvier, who divides his class polypi into two orders; the first of which embraces those that are naked, and the second, such as live in polypiferous masses, formed by the united labours of the community. These he subdivides into many families.

Minute as the beings are which construct and inhabit those stony masses called corals, they form one of the largest, and undoubtedly the most singular of the whole classes of animated being. Such is the enormous accumulation of the stony envelopes formed by them in tropical seas, that islands are produced, coasts extended, and harbours blocked up by them. It was the opinion of Lamarck, that it was these minute beings who originally formed the calcareous strata of the globe.

In contemplating the structure of the polypi, the hydra, for example, we find their nutritive organs the simplest of all possible forms; consisting of a mere stomach adapted to receive and digest food, without any other

which they are all possessed, and with which they have a slow progressive motion ; but the moderns have given the name of Polypus to a reptile that lives in fresh water, by no means so large or observable. These are found at the bottom of wet ditches, or attached to the under surface of the broad-leafed plants that grow and swim on the waters. The same difference

apparent organ, being destitute of brain, nerves, or organs of sense ; nor is there the slightest appearance of any thing corresponding to lungs, heart, or even vessels of any kind. We have given a magnified representation of the hydra, laid open by a longitudinal section, pl. 30, f. 79, exhibiting the cavity into which the food is received and digested. The walls of this cavity must be adapted not only to prepare and pour out the fluids by which the food is digested, but also to permit of the transudation through its substance,—probably by means of invisible pores,—of the nutritious particles thus extracted from the food for the purpose of its being incorporated and identified with the gelatinous pulp, of which the body appears wholly to consist. The researches of Trembley have brought to light the extraordinary fact, that not only the internal surface of the polypus is endowed with the power of digesting food, but that the same property belongs also to the external surface, or what we might call the skin of the animal. He found that by a dexterous manipulation, the hydra may be completely turned inside out, like the finger of a glove, and that the animal, after having undergone this singular operation, will very soon resume all its ordinary functions, just as if nothing had happened. It accommodates itself in the course of a day or two to the transformation, and resumes all its natural habits, eagerly seizing animalcules with its tentacula, and introducing them into its newly formed stomach, which has for its interior surface what before was the exterior skin, and which digests them with perfect ease. The truth of this wonderful discovery was subsequently confirmed by Bonnet and Spallanzani.

Still more complicated are the forms and economy of the aggregated polypi, which prolific nature has spread in countless multitudes, over the rocky shores of the whole globe. These grow in the form of plants, and are supported on one common stem, with widely extended flowering branches. These many-headed monsters present myriads of open mouths, each surrounded by single or numerous rows of tentacula, which are extended to catch their prey; these are provided with a multitude of cilia, which, by their incessant vibrations, determine currents of water to flow towards their mouths, carrying with them the floating animalcules on which the entire mass of polypi subsists.

Each mouth leads into a separate stomach, whence the food, after its digestion, passes into several channels, generally five in number, which proceed in different directions from the cavity of each stomach, dividing into many branches, and being distributed over all the surrounding portions of the flesh. These branches communicate with similar channels, proceeding from the neighbouring stomachs, so that the food which has been taken in by one of the mouths, contributes to the general nourishment of the whole mass of aggregated polypi.

The polypi appear in general not to be provided with any distinct channels for conveying aerated water into the interior of their bodies, so that it may act in succession on the nutritive juices, and, after performing this office, may be expelled, and exchanged for a fresh supply. It has accordingly been conjectured, on the presumption that this function is equally necessary to them as it is to all other animals, that the vivifying influence of the surrounding element, is exerted through the medium of the surface of the body. Thus it is very possible that in polypi, while the interior surface of the sac digests the food, its external surface may perform the office of respiration ; and no other mode of accomplishing this function has been distinctly traced in the animals of the order acalepha.

The form of the shelly covering which invests most of the polypi, admits of almost infinite variety. In some it encloses the flesh in a general sheath, leaving only an opening at the end, sufficient for the expansion of each set of tentacula, surrounding the various mouths of the respective animals. In some species these tubes are placed parallel to each other, in the manner of the pipes of an organ, with transverse partitions at regular intervals for their support ; as exemplified in the *Tubipora Musica*, pl. 30, f. 34 and 66. This last figure represents a portion of the tubes highly magnified, and laid open to show the polypi in their interior. Sometimes the tubes are united together endwise, like the branches of a tree, leaving lateral apertures for the animals to extend their tentacula through as exemplified in the *sertularia frutescens*, pl. 30, f. 4 and 10. In some species the horny base is formed into a number of cells, each of which answers the purpose of protecting its respective polype. These are usually situated at the extremity of the branches, and have all the appearance of flowers, as may be seen in the *tabularia ramosa*, pl. 30, f. 59, 60. The different species of the genus *Flustra*,—as will be seen in the species *carbacea*, pl. 30, f. 61, and F. *foliacea*, f. 12,—have the cells excessively minute. These are extended over a flat membraneous substance, having all the appearance of the leaves of plants. These cells are formed in very regular rows, as in the magnified representation of F. *foliacea*, f. 1, and are arranged with as much regularity as the cells of a honeycomb. Nearly the whole of the animals which constitute the other polipiferous masses have an internal inorganic base of support, constituting a kind of skeleton or axis ; the mouths of the polypi being developed at intervals over the surface of the fleshy layer by which this skeleton is covered. This is especially the case with the genera *Gorgonia*, *Antipathes*, and *Corallium*, as they bear the strongest similitude to the branched forms of the stems of vegetables. The flesh contains grains of calcareous matter, which, in the dried specimens, adhere to the surface of the stems. Plate 30, f. 6, is a branch of *Coralium rubrum*, exhibiting the appearance presented by the polypi in their expanded and contracted conditions. F. 7 is the polype of the same, greatly magnified. In many instances the polypi are located in cup-like depressions, situate in the surface of the calcareous axis, which protects them considerably. In the genus *Madrepora*, these depressions are intersected by radiating *plates*, adapted to the number and construction of the tentacula ; and in the *Millepora* the cells are closer and more minute, and do not exhibit any of the star-like radiations. In some species the plates have more of a parallel arrangement ; and in others they form a reticulated appearance.

The materials of which the axis is composed are invariably arranged in concentric layers, thus indicating that their deposition has been successive, and the surface is always marked by longitudinal lines corresponding to the figure of the animal covering the flesh. In some genera the stem consists of horny and calcareous parts alternately disposed, composing a jointed structure. This has been by some naturalists considered an approximation to an articulated skeleton ; as it is susceptible of considerable flection, and yields readily to the currents or waves, without being broken. An example of this structure is seen in the *Isis Hippuris*, pl. 30, f. 21.

Almost the entire class of polypi are attached, by the root of the stem or base, to submarine rocks or other extraneous bodies. The roots are possessed of a very strong adhesive quality.

holds between these and the sea-water polypus, as between all the productions of the sea, and of the land and the ocean. The marine vegetables and animals grow to a monstrous size. The eel, the pike, or the bream, of fresh-waters is but small; but in the sea they grow to an enormous magnitude. The herbs of the field are at most but a few feet high;

The reproduction of all the adhesive polypi depends upon the detachment of gemmules,* or imperfectly formed portions of their soft substance. These gemmules are possessed of active powers of locomotion, apparently for the sole purpose of seeking a place whereon to raise its future habitation at a distance from its parents. This situation once chosen, it is immovably fixed to that spot during its natural life. In the earlier state these gemmules appear on the surface of the parent animal, in the form of small specks, which are visible to the naked eye. In the course of a few months they enlarge in size, and each becomes pyriform, and are observed to protrude from the sides of the internal canals of the parent, adhering by their narrow ends. This form in particular applies to the young of sponges. Shortly after, they are freed, the one after the other, and are borne along by the currents of fluid, which are quickly passing out of the larger openings. Pl. 30, f. 75, represents one of these detached gemmules. Were these devoid of life, they would naturally sink to the bottom by their own gravity, but on the contrary they spontaneously swim about for two or three days, with their broad end forwards. These gemmules, upon microscopic examination, are found to be about two-thirds covered with short cilia, which are in constant and rapid motion: they are extremely minute and transparent, broadest at the base, and tapering to almost invisible points. The strokes of these cilia are made without any regular order, but conspiring to propel the gemmule with the broad end forwards, but without seeming to have an apparent object in view, by a slow gliding motion, quite unlike the zigzag course of animals in search of prey. They appear, however, to have a consciousness of impressions made on them; for if they come in collision with each other, or if they strike against any object, the motion of their cilia is for a short time suspended; they wheel round the spot for some seconds, then renew their vibratory motion, and proceed in their former course.

It is by the narrow extremity that these gemmules become adherent, which soon begins to expand itself laterally, so as to form a broad base of attachment. While this is proceeding, the cilia continue to move rapidly, but their motions soon become languid, and in a very few hours cease entirely to move, and finally disappear, being no longer of use. The same mode of proceeding is common to the gemmules of all the class polypi, except that there is a variety in the head of the gemmules which swims first. The time of their remaining in a free condition varies with the species, from a few hours to three days.

The tentacula of polypi are exquisitely sensible, and are frequently seen, either singly or collectively, curving their extremities towards the mouth, when any minute floating body comes in contact with them. During the time a polype is expanded, a constant current of water is directed towards the mouth: the currents are never produced by the motions of the tentacula themselves, but are always the effects of rapid vibrations of the cilia placed on the tentacula. The polypi of the *Flustra carbasea*, for example, f. 62, pl. 30, have each tentacula, provided with a single row of cilia, extending along both the lateral margins, from their base to their termination: as we have represented at f. 63, in a portion of one of their tentacula, highly magnified. Every polype is furnished with twenty-two tentacula, and there are about fifty cilia on each side of a tentaculum, so that every individual polype has no less than two thousand two hundred cilia. Every square inch contains about one thousand eight hundred cells; the branches of an ordinary specimen present about ten square inches of surface, so that an ordinary specimen of this species presents a congregation of not less than eighteen thousand polypi; with three hundred and ninety-six tentacula, and thirty-nine millions six hundred thousand cilia; while other species undoubtedly contain more than ten times these numbers. Dr Grant has estimated that there are about *four hundred millions* of cilia on a single *Flustra foliacea!* the species which we have represented, f. 12. We have given a representation of a gemmule of the *Flustra carbasea*, pl. 30, f. 64.

It is still an unsettled point whether the aggregated mass is to be considered as one individual, endowed with a common principle of life and growth, or whether each mouth is to be regarded as the organ of a separate animal. Dr Grant is of opinion that the detached polypi called *pennatula*, or sea pens, f. 14, pl. 30, do not possess a voluntary power of locomotion, but that they are carried along by the currents of the ocean. Indeed, none of all this extensive tribe of beings which are invested in a stony covering, or which have a horny or calcareous axis, have the power of locomotion; and it is not until we descend to animals divested of these, that we can trace animals having this power. The fresh-water polypi, called *hydra*, are locomotive. These animals present us with the simplest kind of structure which has yet been ascertained. The hydra consists simply of a fleshy tube, open at both extremities, and the aperture of the tube serving as a mouth, which is situate in the more dilated end, and this mouth is provided at its margin with a single row of tentacula. Looking to this animal, we may suppose that nature has formed it, to prove that animal life may be carried on without the aid of the complicated machinery which she has given to the higher orders of creation. The hydra can change place at will. F. 69, pl. 30, represents the *hydra viridis*. This animal has the power of fixing itself in an erect position by the foot, and if it wishes to change place, it slowly bends till its head touches the plane on which it is moving, and adheres to it by the mouth, or by one or two of its tentacula; the foot is then detached, and by a curve of the body placed close to the head, where it is again fixed, preparatory to a new step, which it performs by a repetition of the same movements.

Sponges, in their general aspect, have much the appearance of plants, and they were by many regarded as such; but it has been satisfactorily ascertained that they are composed of soft flesh, intermixed with a tissue of fibres, some of which are solid, others tubular, and the whole being curiously interwoven into a kind of network. It will be perceived, on examining f. 70, pl. 30, that every part of a living sponge presents to the eye two kinds of orifices, the larger being somewhat round in its shape, with the margins raised, forming projecting papillæ; the smaller being much more numerous, exceedingly minute, and are usually termed the pores of the sponge.

For many ages, indeed, so far back as the time of Aristotle, who died 322 years before the birth of Christ, sponges were supposed to be so sensitive, that they shrunk from the touch; and later naturalists asserted that, if punctured by sharp instruments, they would exhibit visible tremulous motions. But Dr Grant has most effectually refuted this error, by subjecting sponges to the most severe experiments, such as lacerating, puncturing, burning, or otherwise wounding their texture, by

* The word *Gemmule* is taken from the Latin word *gemma*, a bud; and its meaning, as applied to polypi, is that of a young animal, not contained within an envelope or egg.

those of the sea often shoot forth a stalk of a hundred. It is so between the polypi of both elements. Those of the sea are found from two feet in length to three or four, and Pliny has even described one, the arms of which were no less than thirty feet long. Those in fresh waters, however, are comparatively minute; at their utmost size seldom above three

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the application of corrosive chemical agents. He has discovered the true nature of the currents of fluid issuing at different points, which he thus graphically describes: "I put a small branch of the *spongia coalita*, with some sea-water, into a watch-glass, under the microscope, and, on reflecting the light of a candle through the fluid, I soon perceived that there was some intestine motion in the opaque particles floating through the water. On moving the watch-glass, so as to bring one of the apertures on the side of the sponge fully into view, I beheld, for the first time, the splendid spectacle of this living fountain, vomiting forth, from a circular cavity, an impetuous torrent of liquid matter, and hurling along, in rapid succession, opaque masses, which it strewed every where around. The beauty and novelty of such a scene in the animal kingdom, long arrested my attention, but after twenty-five minutes of constant observation, I was obliged to withdraw my eye from fatigue, without having seen the torrent for one instant change its direction, or diminish, in the slightest degree, the rapidity of its course." It thus appears that the large orifices on the surface of a living sponge, are destined for the discharge of a constant stream of water from the interior of the body. We have attempted to represent the particles thrown out by these currents in f. 70. These currents, issuing from the larger orifices, are best seen by placing the living animal in a shallow vessel of sea-water, and strewing a little powdered chalk over the surface, the motions of which render the current very sensible to the naked eye. It is by the myriads of minute pores, which exist in every part of the surface, that this water enters, conveying with it the materials necessary for the subsistence of the animal. These pores conduct the fluid into the interior, where, after percolating through the numerous channels of communication which pervade the substance of the body, it is collected into wider passages, terminating in the focal orifices above described, and is finally discharged. The mechanism by which these currents are produced, is involved in much obscurity.

The genus *vorticella* is constituted of a small tribe of animals which differ from the polypi in one particular, namely, that of being destitute of tentacula, and having cilia only, surrounding the margin of a bell-shaped body, which is mounted upon a long, slender peduncle. The animals of this genus are always attached to some extraneous body by this footstalk, as represented in *vorticella polypina*, pl. 30, f. 75, but have the power of moving about in all directions, to the extent of the range of the footstalk. Currents are, as usual, excited by the vibrations of the cilia, and these are the efficient instruments of progressive motion. The ordinary position of the peduncle of the vorticella is spiral, but it can extend it quite in a straight line when in search of food; but it suddenly retreats from danger, by resuming the spiral folds of its peduncle.

Lamarck arranges the polypi under five orders, with the following characters:—

I. Polypi Natantes.—Polypi provided with tentacula, united in a common fleshy mass, placed on an axis, free, and floating in the water.

II. Polypi Tubiferi.—Tentaculated polypi united in a common fleshy body, without any solid axis, and covered with tubiform cylinders.

III. Polypi Vaginati.—Polypi with tentacula, always fixed in an inorganic covering, and forming in general compound animals.

IV. Polypi Denudati.—Tentaculated polypi not forming a common envelop, fixed either constantly or spontaneously.

V. Polypi Ciliati.—Polypi without any tentacula; but instead of them, vibratile ciliæ, at or near the mouth.

ORDER I.—POLYPI NATANTES.

Polypi united in a common fleshy body, or congregated mass, free, elongated, enveloping an inorganic axis, cartilaginous, osseous, or stony; each polypus provided with tentacula placed around the mouth, and radiating. The animals of this order are congregated on a common body, in which they all participate, while each appears to enjoy a separate existence, and distinct powers of volition. The common body has the appearance of a naked fleshy mass, with the polypi protruding from its surface, and in the centre is placed an inorganic axis resulting from some deposition of the animals, in the same manner as the outer covering in the other orders. Some of these compound animals float freely in the water, and others remain at the bottom in the mud or sand. Many of them diffuse a vivid phosphorescent light. *Umbellularia Greenlandica*, pl. 30, f. 13. Body free, consisting of a long simple stem, with a bony inarticulated axis, enveloped by a fleshy membrane. Inhabits the Northern ocean. *Virgularia;* body free, filiform or linear, greatly elongated. Inhabits the Northern ocean. *Renilla;* body free, depressed, kidney-shaped, polypi provided with six rays each. *Pennatula phosphorea*, pl. 30, f. 14. Body free, fleshy, penniform, polypi with radiated tentacula. Fig. 65 represents some of the polypes greatly magnified. Inhabits the British seas. *Funiculina;* body free, filiform, very simple, long, fleshy, and provided with warts. Inhabits the American ocean. *Veretillum;* body free, fleshy, simple, cylindrical, polypiferous above, and with the base naked.

ORDER II.—POLYPI TUBIFERI.

Polypi united in a common fleshy body, either simple, lobed, or ramified, and constantly fixed at its base, destitute of any solid internal axis; surface entirely or in part covered with tubiform cylinders, rarely retractile; mouth terminal, provided with eight pectinated tentacula. The tubiferous polypi always exist in the form of a fleshy subgelatinous body, invariably fixed by their base. They are more or less simple, convex, lobed, or slightly ramified. The upper part of the surface of their body is covered with a vast number of small tubiform movable cylinders; having at their summit a roundish sub-octagonal mouth surrounded by eight pectinated tentacula. *Lobularia digitata*, pl. 30, f. 15. Common body of a fleshy consistence, elevated upon the base. Inhabits the coast of Europe. Fig. 16 is a magnified view of a portion of this species. *Cliona;* of a fleshy, irritable substance, provided with siliceous spicula, generally embedded in the cavities of shells. Inhabits empty oyster shells on the British coasts. *Ammothea;* with the common body divided into many short and branched stems. Inhabits the coasts of the Red sea. *Xenia;* the common body provided with thick, somewhat short, naked stems, emanating from the base, and divided at their summit. *Anthelia;* common body spread out in a thin plate, or depressed over marine substances. Inhabits the shores of the Red sea.

ORDER III.—POLYPI VAGINATI.

Each individual polype tentaculated, constantly fixed in an inorganic body, or sheath, which completely envelops them, and forming in general compound animals. This is the most extensive class of polypi, and is divided into seven sections. The animals are very delicate, transparent, and extremely contractile, usually fixed in an inorganic body of their own formation. This calcareous mass is increased in size with every successive generation; and these, in the course of time, accumulate to such a size, that they raise islands in the midst of the ocean. The cells are short, long, or tubular, the orifice

parts of an inch long, and when gathered up into their usual form, not above a third even of those dimensions.

It was upon these minute animals that the power of dissection was first tried in multiplying their numbers. They had been long considered as little worthy the attention of observers, and were consigned to that neglect in

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sometimes irregular, and at others regular: the interior walls, being simple, longitudinally striated, or lamellated, and stelliform.

SECTION I.

The polypiferous masses composed of two distinct parts; the *first* consisting of numerous horny fibres, either in fasciculi, radiated, interlaced, crossed, or fitted together; the *second* is composed of a fleshy or gelatinous pulp; covering, enveloping, or attaching the fibres, containing the polypi, and assuming in drying a consistence more or less firm. *Alcyonium gorgonoides*, pl. 30, f. 9. The polypiferous masses polymorphous, soft, or fleshy, when recent, but somewhat coriaceous and firm when dried. *Geodia;* the polypiferous mass free, fleshy, tuberous, hollow interiorly. *Tethia;* with a knotty subglobular polypiferous mass, the interior with numerous, fasciculated fibres *Spongia tubulosa*, pl. 30, f. 5. Polypiferous mass soft, gelatinous, very flexible, and fixed; the cartilaginous matter supported by calcareous or siliceous spicula; pores excessively numerous and irregular. The spicula are represented at figs. 71 and 72. It will be seen by the *Spongia coalita*, f. 70, that there are two kinds of orifices; the larger having a rounded shape, provided generally with raised margins, which form projecting papillæ, the smaller being much more numerous, exceedingly minute, and constituting what are termed the pores of the sponge. *Flabellaria pavonia*, pl. 30, f. 17. The polypiferous mass caulescent, fan-shaped, incrusted, and frequently divided. Inhabits the seas of America. *Fincrassata*, pl. 30, f. 2. *Penicillus capitatus*, pl. 30, f. 18. Polypiferous mass, supported on a simple, exteriorly incrusted stalk, filled interiorly with many horny fasciculated fibres, and divided at its summit into a cluster of filiform, dichotomous, articulated branches. Fig. 19 shows the articulations magnified.

SECTION II.

The polypiferous masses branched like plants, and composed of two kinds of substance, namely, a central solid axis, and a fleshy incrustation, which invests and contains the polypi; axis inorganic, corneous, or stony; when dried the polypiferous crust is porous, cellular, and friable. *Corallina corniculata*, pl. 30, f. 11. Polypiferous mass adherent, greatly branched. Inhabit the American and European seas. Fig. 4 is a magnified view of some branches. *Gorgonia verriculata*, pl. 30, f. 8. Polypiferous mass branched and adherent. Indian seas. *Antipathes spiralis*, pl. 30, f. 20. Polypiferous mass adherent and branched. Indian ocean. *Isis hippuris*, pl. 30, f. 21. Polypiferous mass arborescent, and fixed. Indian ocean. *Melitæa;* adherent, tree-shaped, having a jointed knotty axis. *Corallium rubrum*, pl. 30, f. 6. Adherent, branched, stiff, and devoid of articulation. Fig. 7 represents one of the polypi greatly magnified. Indian ocean.

SECTION III.

With stony polypiferous masses, having star-shaped, or waved laminar furrows.

1. With Lateral Stars, or spread over the surface.

Oculina prolifera, pl. 30, f. 22. Polypiferous mass of a stony consistence. Northern ocean. *Seriatopora subulata*, pl. 30, f. 23. Adherent, stony, with slender, subcylindrical branches. *Madrepora fungites*, pl. 30, f. 24. Adherent, subdendroidal, branching. West Indian seas. *Pocillopora;* adherent, branched, lobed, and stony. *Porites clavaria*, pl. 30, f. 25. Adherent, stony, branched, or lobed and obtuse, with a stelliferous surface. American and Indian ocean. Fig. 26, this species greatly magnified. *Astrea radiata*, pl. 30, f. 27. Adherent, incrusting marine substances, or forming a hemispherical or globular mass. American seas. *Asteria denticulata*, pl. 30, f. 26. *Explanaria mesenterina*, pl. 30, f. 28. Adherent, stony, exhibiting a free, foliaceous membrane. Indian ocean. *Echinoptera;* adherent, stony, depressed, and extended into a free membrane. *Monticularia;* adherent, stony, incrusting marine substances. *Meandrina labyrinthica*, pl. 30, f. 29. Adherent, stony, forming a simple, convex, or hemispherical mass. American ocean. *Agaricia ampliata*, pl. 30. f. 30. Adherent, stony, with depressed foliaceous expansions. Indian ocean. *Pavonia agaricites*, pl. 30, f. 31. Adherent, stony, frondescent, with depressed subfoliaceous lobes. American seas.

2. Stars terminal.

Fungia agariciformis; free, stony, simple, orbicular, or oblong, convex and lamellar above. Indian seas. *Cyclolites;* free, stony, elliptical or orbicular, convex and lamellar above, with a hollow centre, depressed below. *Turbinolia;* free, simple, turbinated, or wedge-shaped, and acute at the base. *Caryophyllia cyathus*, pl. 30, f. 33. Mass free, stony, simple, or branched. Mediterranean. Fig. 67, *C.* Smithii. Fig. 68, animal fully expanded. *Sarcinula;* free, stony, consisting of a simple, polypiferous, and thick mass. *Stylina;* mass stony, simple, exteriorly rough; tubes numerous.

SECTION IV.

With a stony polypiferous, solid, and interiorly compact mass: cells perforated, or tubular, and destitute of laminæ. *Tubipora musica*, pl. 30, f. 34. Stony, composed of cylindrical tubes, which are straight, and individually separate. Indian seas. Fig. 66 is a magnified portion of the tubes. *Catenipora;* stony, composed of parallel tubes, inserted in the thickness of vertical plates, anastomosed like net-work. *Favosites;* stony, simple, variable in form, composed of parallel prismatic tubes. *Millepora calcarea*, pl. 30, f. 35. Stony, interiorly solid, polymorphous, branched, or frondescent. European seas. *Distichopora;* adherent, solid, stony, with slightly compressed branches. *Orbulites;* free, stony, orbicular, depressed, or slightly concave. *Lunulites;* free, stony, orbicular, depressed. *Ovulites;* free, stony, egg-shaped, or cylindrical; known only in a fossil state.

SECTION V.

Polypiferous masses of a substony consistence, with frondescent or crustaceous expansions; cells small, short, sometimes in a regular series, at other times irregular, and usually disposed at the surface of the expansions of marine substances. *Dactylopora;* free, stony, cylindrical, obtuse at one extremity, contracted and perforate at the other. *Ocellaria;* stony, depressed as a membrane, variously twisted, somewhat funnel-shaped. *Alveolites;* stony, either forming incrustations, or a free mass disposed in numerous concentric layers, covering one another. *Retepora cellulosa*, pl. 30, f. 36. Stony, interiorly porous, with thin depressed expansions. *Adeona;* nearly stony, caulescent, or fan-shaped. *Eschara foliacea*, pl. 30, f. 37. Nearly stony, but not flexible. *Cellepora pumicosa*, pl. 30, f. 38. Nearly stony, interiorly porous, spreading in a raised, foliaceous crust. Fig. 39 is a magnified view of this mass of polypi. European seas. *Discopora;* suberustaceous, depressed, extended in an undulated, discoid, stony plate, with the upper surface cellular. *Tubulipora transversa*, pl. 30, f. 40. Consisting of a parasitical or incrusting mass, with submembranous cells disposed in clusters or series, and mostly free. Fig. 41, one of the warts magnified. Fig. 42 represents one of the particles of which the crust is composed. Mediterranean. *Flustra foliacea*, pl. 30, f. 12. Flexible, submembranous, stony and frondescent, or consisting of a thin crust, formed of contiguous cells. Fig. 1 is a magnified view of the cells. European seas. *Flustra carbasea*, pl. 30, f. 61, is the

which thousands of minute species of insects remain to this very day. It is true, indeed, that Reaumur observed, classed, and named them. By contemplating their motions, he was enabled distinctly to pronounce on their being of the animal and not of the vegetable kingdom; and he called them polypi, from their great resemblance to those larger ones that were found in the ocean. Still, however, their properties were neglected, and their history unknown.

Mr Trembley was the person to whom we owe the first discovery of the amazing properties and powers of this little vivacious creature. He divided this class of animals into four different kinds: into those inclining to green, those of a brownish cast, those of a flesh colour, and those which he calls the *polype de panache*. The differences of structure in these, as also of colour, are observable enough; but the manner of their subsisting, of seizing their prey, and of their propagation, is pretty nearly the same in all.

Whoever has looked with care into the bottom of a wet ditch when the water is stagnant, and the sun has been powerful, may remember to have seen many little transparent lumps of jelly, about the size of a pea, and flatted on each side; such also as have examined the under side of the broad-leafed weeds that grow on the surface of the water, must have observed them studded with a number of these little jelly-like substances, which were probably then disregarded, because their nature and history were unknown. These little substances, however, were no other than living polypi, gathered up into a quiescent state, and seemingly inanimate, because either undisturbed, or not excited by the calls of appetite to action. When they are seen exerting themselves, they put on a very different appearance from that when at rest: to conceive a just

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polypiferous mass. Fig. 62 represents the tentacula in the polypes of this species. Fig. 63 is a portion of one of these tentacula highly magnified. Fig. 64 is a delineation of one of the gemmules, greatly magnified. Fig. 78 is a part of *F. verticiliata* greatly magnified.

SECTION VI.

Polypiferous masses consisting of one substance only, slender, fistulous, membranous, or horny stems, flexible and branched, containing polypi in their interior. *Polyphysa;* polypiferous mass fungoid, with a calcareous crust. *Acetabulum;* fungoid, with a calcareous crust. *Tibiana;* adherent, tubular, membranaceous, or horny. *Dichotomaria fruticulosa*, pl. 30, f. 43. Polypiferous mass with tubular, subarticulate, dichotomous stems, and a calcareous incrustation. American seas. Fig. 44 represents the *D. obtusata*, an inhabitant of the coasts of the Bahama islands. *Anguinaria spatulata*, pl. 30, f. 45. Adherent, and extending itself in the form of a plant. Fig. 46 is a magnified portion. *Cellaria thuia*, pl. 30, f. 47. Adherent, with the stems tubular and branched. Fig. 48, a portion of a stem magnified. European seas. *Liriozoa Caribæa*, pl. 30, f. 49. Adherent, branched, calcareous; with tubular stems, jointed, creeping. Fig. 50, a portion of a stem magnified. West Indian seas. *Serialaria lendigera*, pl. 30, f. 51. Adherent, branched, horny, stems, slender. Fig. 52, a portion of a stem magnified. European seas. *Plumularia myriophillum*, pl. 30, f. 53. Adherent, branched, horny, stalks slender. Fig. 54, a portion of a stem magnified. European seas. *Antennularia ramosa*, pl. 30, f. 55. Adherent, horny, with the stems fistulous, simple, or branched. Fig. 56, a portion of a stem magnified. European seas. *Sertularia frutescens*, pl. 30, f. 10. Adherent, horny, stems slender and fistulous. Fig. 4, a portion of a stem magnified. European seas. *S. abietina*, pl. 30, f. 73 and 77. *Campanullaria verticillata*, pl. 30, f. 57. Adherent, stems fistulous, filiform, horny, simple, or branched. Fig. 58, a magnified portion of a branch. *Cornularia;* adherent, horny, with simple, funnel-shaped stems. *Tubularia ramosa*, pl. 30, f. 59. Adherent, slender, tubular, simple, or branched, horny. Fig. 60, a magnified portion of a branch. British seas. Fig. 74, *T. magnifica.* Tropical seas. *Plumatella;* adherent, slender, tubular, branching, submembranous, extremities of stems and branches terminated each by a polypus.

SECTION VII.

Polypiferous masses either free, isolated, and floating in the water, or adherent, and agglomerated in cellular masses, composed of one substance on aquatic bodies; polypi provided with numerous tentacula, which do not complete the circle round the mouth. The animals of this section chiefly inhabit fresh water. *Alcyonella;* incrusting, thick, convex, and irregular, consisting of an aggregation of vertical subpentangular tubes, open at their summit. *Spongilla;* adherent polymorphous, cellular, irregular, composed of subpiliferous laminæ. *Cristatella;* free, globular, gelatinous, covered by short, thick, polypiferous tubercles, each of which encloses a polypus. *Difflugia;* body small, gelatinous, contractile, enclosed in a testaceous tube, projecting.

ORDER IV.—POLYPI DENUDATI.

Polypi provided with tentacula, and not forming a polypiferous mass; greatly diversified in form, in the number and situation of their tentacula, and fixed either constantly or spontaneously. *Pedicellaria;* adherent, formed of a stiff peduncle. *Coryne;* fleshy, seated on a peduncle. *Hydra viridis*, pl. 30, f. 76. Oblong, linear, in the form of a reversed cone, narrowed below, gelatinous, transparent, and fixed spontaneously by the base. *a.* exhibits the body extended, and *b.* the body in a contracted state. Fig. 69, body expanded. Inhabits fresh waters.

ORDER V.—POLYPI CILIATI.

Mouth provided with ciliated and gyratory organs which agitate the water, but do not seize the food.

SECTION I.—ROTIFERI.

With one or many organs in a circular form, ciliated, and rotatory at the opening of the mouth. *Tubicolaria;* body contractile, oblong, contained in a tube fixed on aquatic bodies. *Vorticella polypina*, pl. 30, f. 75. Body naked, pedunculated, fixed spontaneously, or constantly by its base. Inhabits stagnant waters. *Urceolaria;* body free, contractile, urceolate, sometimes elongated, without tail or peduncle. *Furcularia;* body free, contractile, oblong, provided with a short or elongated tail. *Brachionus;* body free, contractile, nearly oval, covered, at least partly, by a transparent sheath. *Folliculina;* body contractile, oblong, inclosed in a transparent sheath.

SECTION II.—VIBRATILES.

Ciliæ placed near the mouth, moving in interrupted vibrations. *Vaginicola;* body minute, oval, or oblong, anteriorly ciliated, and provided with a tail; enclosed in a transverse sheath, but not attached. *Trichocerca;* body minute, oval, or oblong, anteriorly truncated. *Rattulus;* body minute, oblong, truncated, or anteriorly obtuse.

idea of their figure, we may suppose the finger of a glove cut off at the bottom; we may suppose also several threads or horns planted round the edge like a fringe. The hollow of this finger will give us an idea of the stomach of the animal; the threads issuing forth from the edges may be considered as the arms or feelers with which it hunts for its prey. The animal, at its greatest extent, is seldom seen above an inch and a half long, but it is much shorter when it is contracted and at rest; it is furnished neither with muscles nor rings, and its manner of lengthening or contracting itself more resembles that of the snail, than worms, or any other insect. The polypus contracts itself more or less, in proportion as it is touched, or as the water is agitated in which they are seen. Warmth animates them, and cold benumbs them; but it requires a degree of cold approaching congelation before they are reduced to perfect inactivity; those of an inch have generally their arms double, often thrice as long as their bodies. The arms, where the animal is not disturbed, and the season not unfavourable, are thrown about in various directions, in order to seize and entangle its little prey; sometimes three or four of the arms are thus employed, while the rest are contracted like the horns of a snail, within the animal's body. It seems capable of giving what length it pleases to these arms; it contracts and extends them at pleasure, and stretches them only in proportion to the remoteness of the object it would seize.

These animals have a progressive motion, which is performed by that power they have of lengthening and contracting themselves at pleasure; they go from one part of the bottom to another; they mount along the margin of the water, and climb up the side of aquatic plants. They often are seen to come to the surface of the water, where they suspend themselves by their lower end. As they advance but very slowly, they employ a great deal of time in every action, and bind themselves very strongly to whatever body they chance to move upon as they proceed; their adhesion is voluntary, and is probably performed in the manner of a cupping-glass applied to the body.

All animals of this kind have a remarkable attachment to turn towards the light; and this naturally might induce an inquirer to look for their eyes; but however carefully this search has been pursued, and however excellent the microscope with which every part was examined, yet nothing of the appearance of this organ was found over the whole body; and it is most probable that, like several other insects which hunt their prey by their feeling, these creatures are unfurnished with advantages which would be totally useless for their support.

In the centre of the arms, as was said before, the mouth is placed, which the animal can open and shut at pleasure, and this serves at once as a passage for food, and an opening for it after digestion. The inward part of the animal's body seems to be one great stomach, which is open at both ends; but the purposes which the opening at the bottom serves are hitherto unknown, but certainly not for excluding their excrements, for those are ejected at the aperture by which they are taken in. If the surface of the body of this little creature be examined with a microscope, it will be found studded with a number of warts, as also the arms, especially when they are contracted; and these tubercles, as we shall presently see, answer a very important purpose.

If we examine their way of living, we shall find these insects chiefly subsisting upon others, much less than themselves, particularly a kind of millepedes that live in the water, and a very small red worm, which they seize with great avidity. In short, no insect whatsoever, less than themselves, seems to come amiss to them; their arms, as was said before, serve them as a net would a fisherman, or perhaps, more exactly speaking, as a lime-twig does a fowler.

Wherever their prey is perceived, which the animal effects by its feeling, it is sufficient to touch the object it would seize upon, and it is fastened without a power of escaping. The instant one of this insect's long arms is laid upon a millepede, the little insect sticks without a possibility of retreating. The greater the distance at which it is touched, the greater is the ease with which the polypus brings the prey to its mouth. If the little object be near, though irretrievably caught, it is not without great difficulty that it can be brought to the mouth to be swallowed. When the polypus is unsupplied with prey, it testifies its hunger by opening its mouth; the aperture, however, is so small that it cannot be easily perceived; but when, with any of its long arms, it has seized upon its prey, it then opens the mouth distinctly enough, and this opening is always in proportion to the size of the animal which it would swallow: the lips dilate insensibly by small degrees, and adjust themselves precisely to the figure of their prey. Mr Trembley, who took a pleasure in feeding this useless brood, found that they could devour aliments of every kind, fish and flesh, as well as insects; but he owns they did not thrive so well upon beef and veal, as upon the little worms of their own providing. When he gave one of these famished reptiles any substance which was improper to serve for aliment, at first it seized the prey with avidity, but after keeping it sometime entangled near the mouth, it dropped it again with distinguishing nicety.

When several polypi happen to fall upon the same worm, they dispute their common prey with each other. Two of them are often seen seizing the same worm at different ends, and dragging it at opposite directions with great force. It often happens, that while one is swallowing its respective end, the other is also employed in the same manner, and thus they continue, swallowing each his part, until their mouths meet together; they then rest, each for some time in this situation, till the worm breaks between them, and each goes off with his share; but it often happens that a seemingly more dangerous combat ensues, when the mouths of both are thus joined upon one common prey together; the largest polypus then gapes and swallows his antagonist; but what is very wonderful, the animal thus swallowed seems to be rather a gainer by the misfortune. After it has lain in the conqueror's body for about an hour, it issues unhurt, and often in possession of the prey which had been the original cause of contention. How happy would it be for men if they had as little to fear from each other!

These reptiles continue eating the whole year, except when the cold approaches to congelation; and then, like most others of the insect tribe, they feel the general torpor of nature, and all their faculties are for two or three months suspended: but if they abstain at one time, they are equally voracious at another, and, like snakes, ants, and other animals, that are torpid in winter, the meal of one day suffices them for several months together. In general, however, they devour more largely in proportion to their size, and their growth is quick exactly as they are fed; such as are best supplied, soonest acquire their largest size, but they diminish also in their growth with the same facility if their food be taken away.

Such are the more obvious properties of these little animals, but the most wonderful still remain behind: their manner of propagation, or rather multiplication, has for some years been the astonishment of all the learned of Europe. They are produced in as great a variety of manner as every species of vegetable. Some polypi are propagated from eggs, as plants are from their seed: some are produced by buds issuing from their bodies, as plants are produced by inoculation; while all may be multiplied by cuttings, and this to a degree of minuteness that exceeds even philosophical perseverance.

With respect to such of this kind as are hatched from the egg, little curious can be added, as it is a method of propagation so common to all the tribes of insect nature; but with regard to such as are produced like buds from their parent stem, or like cuttings from an original root, their history requires a more detailed explanation. If a polypus be carefully observed in summer, when these animals are chiefly active, and more particularly prepared for propagation, it will be found to bourgeon forth from different parts of its body several tubercles or little knobs, which grow larger and larger every day; after two or three days' inspection, what at first appeared but a small excrescence takes the figure of a small animal, entirely resembling its parent, furnished with feelers, a mouth, and all the apparatus for seizing and digesting its prey. This little creature every day becomes larger, like the parent to which it continues attached; it spreads its arms to seize upon whatever insect is proper for aliment, and devours it for its own particular benefit: thus it is possessed of two sources of nourishment, that which it receives from the parent by the tail, and that which it receives from its own industry by the mouth. The food which these animals receive often tinctures the whole body, and upon this occasion the parent is often seen communicating a part of its own fluids to that of its progeny that grows upon it; while, on the contrary, it never receives any tincture from any substance that is caught and swallowed by its young. If the parent swallows a red worm, which gives a tincture to all its fluids, the young one partakes of the parental colour; but if the latter should seize upon the same prey, the parent polypus is no way benefited by the capture, but all the advantage remains with the young one.

But we are not to suppose that the parent is capable of producing only one at a time; several young ones are thus seen at once, of different sizes, growing from its body, some just budding forth, others acquiring their perfect form, and others come to sufficient maturity, and just ready to drop from the original stem to which they had been attached for several days. But what is more extraordinary still, those young ones themselves that continue attached to their parent, are seen to bourgeon, and propagate their own young ones also, each holding the same dependence upon its respective parent, and possessed of the same advantages that have been already described in the first connection. Thus we see a surprising chain of existence continued, and numbers of animals naturally produced without any union of the sexes, or other previous disposition of nature.

This seems to be the most natural way by which these insects are multiplied; their production from the egg being not so common; and though some of this kind are found with a little bladder attached to their bodies, which is supposed to be filled with eggs, which afterwards come to maturity, yet the artificial method of propagating these animals is much more expeditious, and equally certain. It is

indifferent whether one of them be cut into ten, or ten hundred parts, each becomes as perfect an animal as that which was originally divided; but it must be observed, that the smaller the part which is thus separated from the rest, the longer it will be in coming to maturity, or in assuming its perfect form. It would be endless to recount the many experiments that have been tried upon this philosophical prodigy: the animal has been twisted and turned into all manner of shapes; it has been turned inside out, it has been cut in every division, yet still it continued to move; its parts adapted themselves again to each other, and in a short time it became as voracious and industrious as before.

Besides these kinds mentioned by Mr Trembley, there are various others which have been lately discovered by the vigilance of succeeding observers, and some of these so strongly resemble a flowering vegetable in their forms, that they have been mistaken by many naturalists for such. Mr Hughes, the author of the natural history of Barbadoes, has described a species of this animal, but has mistaken its nature, and called it a sensitive flowering plant; he observed it to take refuge in the holes of rocks, and, when undisturbed, to spread forth a number of ramifications, each terminated by a flowery petal, which shrunk at the approach of the hand, and withdrew into the hole from whence before it had been seen to issue. This plant, however, was no other than an animal of the polypus kind, which is not only to be found in Barbadoes, but also on many parts of the coast of Cornwall, and along the shores of the continent.

CHAP. V.

OF THE LITHOPHYTES AND SPONGES.[1]

It is very probable that the animals we see and are acquainted with, bear no manner of proportion to those that are concealed from us. Although every leaf and vegetable swarms with animals upon land, yet at sea they are still more abundant; for the greatest part of what would seem vegetables growing there, are in fact nothing but the artificial formation of insects, palaces which they have built for their own habitation.

If we examine the bottom of the sea along some shores, and particularly at the mouths of several rivers, we shall find it has the appearance of a forest of trees under water, millions of plants growing in various directions, with their branches entangled in each other, and sometimes standing so thick as to obstruct navigation. The shores of the Persian Gulf, the whole extent of the Red sea, and the western coasts of America, are so choked up in many places with these coraline substances, that though ships force a passage through them, boats and swimmers find it impossible to make their way. These aquatic groves are formed of different substances, and assume various appearances. The coral plants, as they are called, sometimes shoot out like trees without leaves in winter; they often spread out a broad surface like a fan, and not uncommonly a large bundling head like a faggot; sometimes they are found to resemble a plant with leaves and flowers; and often the antlers of a stag, with great exactness and regularity. In other parts of the sea are seen sponges of various magnitude, and extraordinary appearances, assuming a variety of fantastic forms, like large mushrooms, mitres, fonts, and flowerpots. To an attentive spectator, these various productions seem entirely of the vegetable kind; they seem to have their leaves and their flowers, and have been experimentally known to shoot out branches in the compass of a year. Philosophers, therefore, till of late, thought themselves pretty secure in ascribing these productions to the vegetable kingdom; and Count Marsigli, who has written very laboriously and learnedly upon the subject of corals and sponges, has not hesitated to declare his opinion, that they were plants of the aquatic kind, furnished with flowers and seeds, and

[1] See the preceding note. There are about fifty different species of sponges, of which nine or ten belong to this country. They are found in the Mediterranean and those seas in warm and temperate latitudes, diminishing in number and becoming of inferior quality on the approach to cold regions. They adhere to rocks in places the least exposed to the action of currents and waves, which the ebbing tide does not leave uncovered. The best sponges known to us are those which come from the Archipelago, where they abound near many of the islands, whose inhabitants may be said to subsist by the sponge-fishery, if we may so call it. At the Cyclades, for instance, sponge-diving forms the chief employment of the population. The sea is at all times extremely clear, and the experienced divers are capable of distinguishing from the surface the points to which the sponge is attached below, when an unpractised eye could but dimly discern the bottom. Each boat is furnished with a large stone attached to a rope, and this the diver seizes in his hand on plunging head foremost from the stern. He does this in order to increase the velocity of his descent; thus economizing his stock of breath, as well as to facilitate his ascent when exhausted at the bottom, being then quickly hauled up by his companions. Few men can remain longer than about two minutes below; and, as the process of detaching the sponge is very tedious, three, and sometimes four divers descend successively to secure a particularly fine specimen.

The best sponge is that which is the palest and lightest, has small holes, and is soft to the touch. By the old physicians, sponge was regarded as a cure for a long list of maladies; this list is now much abridged, though burned sponge, in which form only it is used, still has a place in the materia medica.

endued with a vegetation entirely resembling that which is found upon land. This opinion, however, some time after, began to be shaken by Rumphius and Jussieu, and at last by the ingenious Mr Ellis, who, by a more sagacious and diligent inquiry into nature, put it past doubt, that corals and sponges were entirely the works of animals, and that, like the honeycomb which was formed by the bee, the coral was the work of an infinite number of reptiles of the polypus kind, whose united labours were thus capable of filling whole tracts of the ocean with those embarrassing tokens of their industry.[1]

[1] *Coral.*—The method in which the polypus secretes the coral, which, when taken from the sea, is in stalks about a foot high and half an inch thick, is understood to be as follows: An egg or new animal, when ejected, falls upon some body, to which, from its gelatinous nature, it adheres. On this foundation it spreads and moulds itself, till at length from the middle of it a sort of excrescence rises upwards, containing the germ of a new animal, which attains its growth by degrees, and sends up a similar extension. These deposite calcareous or chalky matter in the middle, and by the constant generation of new polypi, and the secretion of additional matter, the coral, at the end of ten years, which is the period necessary for its perfect growth, has attained the height and thickness mentioned. It is of various colours—red, vermilion, and white, the latter being most common, and consequently least valuable. When taken out of the sea, it is covered with moss and marine vegetable matter, and is generally somewhat softer and duller in hue than it ultimately becomes.

The coral fisheries form a very considerable trade in several parts of the Mediterranean. From the hollows and caverns of the rocks, where it takes root, the coral is brought up with nets; it also grows, but in less quantities, on the sides of the ocean crags. The greatest height to which it attains is never above a foot, and its usual thickness is about that of the little finger, though often much less. The most extensive fisheries are those carried on in the straits of Messina, off the Sicilian coast, and about three miles distant generally from the land. The fishermen have divided the whole tract, about six miles in length, into ten parts. Every year they fish only in one of these parts, and do not interfere with it again till ten years have elapsed, for the purpose of bringing away only such coral as has attained its full growth.

The appearance of the coral as it is observed in the sea, is said to resemble a miniature forest, from its great quantity and branching character. The greatest portion is procured from a depth of from sixty to a hundred and twenty-five feet; but some fisheries are carried on to the depth of nine hundred feet. Those of the coasts of Marseilles, Barbary, and Trapani, are the principal rivals to the Sicilian fisheries in the European market, but none of them produce the coral in equal quantities, or of equal quality, with the latter. From Messina 3000 pounds are said to be exported annually; the price of which is so much affected by the colour and quality, that, while some of it is valued at ten guineas a pound, other portions are considered not worth ten pence. The vermilion-coloured coral, being the rarest, is the most expensive. The common red, however, brings a high price also, when the quality is good. Chemical analysis has proved that the coral consists of carbonate of lime, a species of chalk, for it dissolves completely in aquafortis, or nitric acid.

Though we may regard with some degree of wonder

If, in our researches after the nature of these plants, we should be induced to break off a branch of the coraline substance, and observe it carefully, we shall perceive its

the production of stalks of coral by a small oyster-like polypus, our astonishment cannot fail to be increased when we consider, that, by an animal of the same size and species as the coraliferous polypus, whole reefs of great extent, and even islands, have been founded and originated. The animal or polypus that accomplishes this is called the Madrepore, and has long been erroneously considered as identical with the coral polypus; hence the masses of land alluded to have received the appellation of coral reefs and islands. These have never yet been found in any extent excepting in the Pacific and Asiatic seas, but in these immense waters the coral rocks and reefs are abundant.

The principal groups of islands of coral formation are, from the New Hebrides, eastward, the Friendly islands, Navigation islands, and the Society islands; and, to the northward of the latter group, the Marquesas. These groups are separated from each other by channels or seas, wider than those which separate the individual islands which form the respective groups; but all these waters abound with shoals and minor islets, which indicate the existence of a common base, and show that the processes by which they will hereafter be united above the level of the sea, are in constant operation.

The structure and progress of these islands towards a state of fitness for the habitation of man, has been thus described. At a vast but unknown depth, below the surface of the sea, the insects attach themselves to the upper points and ridges of rocks, which form the bottom of the ocean, and many of which, in the Pacific ocean, are supposed to be of volcanic origin. Upon these foundations, the little architects labour, building up by means of the secretion before described, pile upon pile of their rocky habitations, until at length the work rises above the sea, and is continued to such a height, as to leave it almost dry at low water, when the insect leaves off building upon that part. A solid rocky base being thus formed, sea-shells, fragments of coral, and sea-sand, thrown up by each returning tide, and broken and mixed together, by the action of the waves, become in time converted into a sort of stone, and thus raise up the surface higher and higher. The heat of the sun so penetrates this mass of stone, that it brakes off into flakes, and these flakes are again raised one upon another by the waves, at high water. The ever active surf continues to throw up the shells of marine animals, and other materials, which fill up the crevices between the stones, and the sand upon the surface being now undisturbed, offers to the seeds of trees and plants cast upon it by the waves, a soil upon which they rapidly grow, and over-shadow the dazzling whiteness of the new formed lands. Trunks of trees, washed into the sea by the rivers from other countries and islands, find here a resting place, and with these come some small animals, chiefly of the lizard and insect tribes. Even before the trees form a wood, the sea-birds nestle among them, and soon the stray land-bird takes refuge in the bushes. At a latter period, man appears, builds his hut upon the fruitful soil formed by the corruption of the vegetation, and calls himself lord and proprietor of this new creation.

These islands vary in extent, as well as in the degree of *finish* to which they have arrived. Of thirty-two examined by captain Beechey, the largest was thirty miles in diameter, and the smallest somewhat less than a mile. They were of various shapes, and all formed of living coral, except one, called Henderson's island, which was partially surrounded by it; and they all appeared to be increasing in size by the active operations of the zoophytes, which are gradually extending, and building up

whole surface, which is very rugged and irregular, covered with a mucous fluid, and almost in every part studded with little jelly-like drops, which, when closely examined, will be found to be no other than reptiles of the polypus kind. These have their motions, their arms, their appetites, exactly resembling those described in the last chapter; but they soon expire when taken out of the sea, and our curiosity is at once stopped in its career, by the animals ceasing to give any mark of their industry: recourse, therefore, has been had to other expedients, in order to determine the nature of the inhabitant, as well as the habitation.

If a coraline plant be strictly observed, while still growing in the sea, and the animals upon its surface be not disturbed, either by the agitation of the waters, or the touch of the observer, the little polypi will then be seen in infinite numbers, each issuing from its cell, and in some kinds the head covered with a little shell, resembling an umbrella, the arms spread abroad, in order to seize its prey, while the hinder part still remains attached to its habitation, from whence it never wholly removes. By this time it is perceived, that the number of inhabitants is infinitely greater than was at first suspected; and that they are all assiduously employed in the same pursuits, and that they issue from their respective cells, and retire into them at pleasure. Still, however, there are no proofs that those large branches which they inhabit, are entirely the construction of such feeble and minute animals. But chemistry will be found to lend a clue to extricate us from our doubts in this particular. Like the shells which are formed by snails, mussels, and oysters, these coraline substances effervesce with acids: and may therefore well be supposed to partake of the same animal nature. But Mr Ellis went still farther, and examined their operations, just as they were beginning. Observing an oyster-bed which had been for some time neglected, he there perceived the first rudiments of a coraline plantation, and tufts of various kinds shooting from different parts of this favourable soil.

above the level of the sea those parts which are at present below the water. Twenty-nine of the number had *lagoons*, (or morasses) in the centres, within which, it has been observed, the smaller species of coral seek a quiet abode, and labour silently and slowly, in throwing up banks, which, in process of time, unite with islets that surround them, and at length fill up the *lagoon*, so that what was at first a ring of little islands, becomes one connected mass of land. All these islands are situated within the action of the trade wind, except one (Oeno,) which is on the verge of it, and follow one general rule in having their *windward side* higher, and more protected than the other, and not unfrequently, well wooded, while the other is only a half drowned reef, or wholly under water. At Gambier and Matilda islands this inequality is very conspicuous; the weather-side of both being wooded, and, of the former, inhabited, while the other sides were twenty or thirty feet under water, where they might be perceived equally narrow and well defined. One of these islands (Malden island,) presented the singular appearance of perpendicular coral cliffs, elevated eighty feet above the level of the sea; these were of dead coral, but the outside of the island was surrounded with a belt of living coral, sloping from the cliffs, to from three to twenty-five fathoms under water, after which it descends abruptly to a depth where a 200-fathom line does not reach the bottom. The surface of this island is flat; and it is not easy to account for its present elevation, unless by an earthquake or sub-marine volcanic explosion.

Gambier Group consists of five large islands and several smaller ones, the whole (as well as the five separate islands,) being enclosed in a reef of coral, forming an irregular diamond-shaped space. The older islands are volcanic, and the largest rises in two peaks, 1248 feet above the level of the sea. The outer belt of coral descends abruptly outside to an unfathomable depth, but slopes inward by a decreasing declination, to about 120 or 150 fathoms below the surface; and within this enclosure, a number of low islands are already formed, and others are in progress, rendering it almost certain that, in process of time, the whole space will become one island, each of the original islands being also inclosed with its own reef. These are inhabited by a race of men with fine Asiatic countenances, wearing mustachios and beards, and they appeared to be more civilized than those of many other islands. Specimens of spars, crystals, alumine, jasper, and chalcedony, have been procured on these islands by the naturalists who accompanied captain Beechey. They are covered with a deep soil, and well wooded with trees and evergreens of different kinds.

It is a fact worthy of remark, that on all these islands, a plentiful supply of fresh and sweet water may be obtained, by digging three or four feet into the coral; and that even within one yard of high water mark, such a supply is to be found. This is an important consideration to the navigators of those seas, where such a resource is so valuable, on account of the extreme heat to which they are exposed; and it shows also the powerful properties of the coral, in divesting the sea-water of its saline particles. These properties, which are probably *chemical*, and not merely the effect of filtration, have never been examined or experimented upon, but they furnish a subject of consideration for the naturalist, and the man of science.

Of the rapidity with which the coral grows, we are not in possession of sufficient information, on which to form a correct judgment. Matilda, or Osnaburg island, is supposed to have been only a reef of rocks, when the Matilda was wrecked there, in 1792; it is now an island, fourteen miles in length, and covered on one side with tall trees, and the lagoon in the centre is dotted with columns. The coral, therefore, has probably made a rapid growth since 1792, although Captain Beechey found two anchors of a ton weight each, and a kedge anchor, which he supposes belonged to the Matilda, thrown upon the sunken reef of live coral, and around these anchors, the coral had made no progress in growing, while some large shell-fish, adhering to the same rock, were so overgrown with coral, as to have only space enough left to open about an inch. It is probable, however, that the oxide proceeding from the anchors may have been prejudicial, as far as its effects extended, to the coral insect, and thus have prevented its growth. All navigators, who have visited these seas, state that no charts or maps are of any service after a few years, owing to the number of fresh rocks and reefs which are continually rising to the surface; and it is perfectly accordant with the instincts of animals, to continue working without intermission, until their labours are consummated or their lives are extinct.

It was upon these he tried his principal experiment. He took out the oysters which were thus furnished with coralines, and placed them in a large wooden vessel, covering them with sea-water. In about an hour, he perceived the animals, which before had been contracted by handling, and had shown no signs of life, expanding themselves in every direction, and appearing employed in their own natural manner. Perceiving them, therefore, in this state, his next aim was to preserve them thus expanded, so as to be permanent objects of curiosity. For this purpose, he poured, by slow degrees, an equal quantity of boiling water into the vessel of sea-water in which they were immersed. He then separated each polypus with pincers from its shell, and plunged each separately into small crystal vases, filled with spirit of wine mixed with water. By this means the animal was preserved entire, without having time to contract itself, and he thus perceived a variety of kinds, almost equal to that variety of productions which these little animals are seen to form. He has been thus able to perceive and describe fifty different kinds, each of which is seen to possess its own peculiar mode of construction, and to form a coraline that none of the rest can imitate. It is true, indeed, that on every coraline substance there are a number of polypi found, no way resembling those which are the erecters of the building: these may be called a vagabond race of reptiles, that are only intruders upon the labours of others, and that take possession of habitations which they have neither art nor power to build for themselves. But, in general, the same difference that subsists between the honeycomb of the bee, and the paper-like cells of the wasp, subsists between the different habitations of the coral-making polypi.

With regard to the various forms of these substances, they have obtained different names from the nature of the animal that produced them, or the likeness they bear to some well-known object, such as corallines, fungi-madrepores, sponges, astroites, and keratophytes. Though these differ extremely in their outward appearances, yet they are all formed in the same manner by reptiles of various kinds and nature. When examined chemically, they all discover the marks of animal formation; the corals, as was said, dissolve in acids, the sponges burn with an odour strongly resembling that of burnt horn. We are left somewhat at a loss with regard to the precise manner in which this multitude of cells, which at last assume the appearance of a plant or flower, are formed.

If we may be led in this subject by analogy, it is most probable, that the substance of coral is produced in the same manner that the shell of the snail grows round it: these little reptiles are each possessed of a slimy matter, which covers its body, and this hardening, as in the snail, becomes a habitation exactly fitted to the body of the animal that is to reside in it; several of these habitations being joined together, form at length a considerable mass; and as most animals are productive in proportion to their minuteness, so these multiplying in a surprising degree, at length form those extensive forests that cover the bottom of the deep.

Thus all nature seems replete with life; almost every plant on land has its surface covered with millions of these minute creatures, of whose existence we are certain, but of whose uses we are entirely ignorant; while numbers of what seem plants at sea, are not only the receptacles of insects, but also entirely of insect formation. This might have led some late philosophers into an opinion, that all nature was animated; that every, even the most inert, mass of matter was endued with life and sensation, but wanted organs to make those sensations perceptible to the observer: those opinions, taken up at random, are difficultly maintained, and as difficultly refuted; like combatants that meet in the dark, each party may deal a thousand blows without ever reaching the adversary. Those, perhaps, are wiser who view nature as she offers; who, without searching too deeply into the recesses into which she ultimately hides, are contented to take her as she presents herself; and storing their minds with effects rather than with causes, instead of the embarrassments of systems, about which few agree, are contented with the history of appearances, concerning which all mankind have but one opinion.

SUPPLEMENT

ON

CRUSTACEA AND MOLLUSCA.

NATURALISTS have experienced much difficulty in finding an appropriate place for *Crustacea*. In the present volume, they will be found described along with *Mollusca*, in book IV. of Goldsmith's history of Fishes, p. 326, *et seq.* To Goldsmith's description we have added most copious notes; and little more will be required here than to give the scientific arrangement of the animals, as figured in the illustrative plates.

The crustacea (which include crabs, lobsters, prawns, shrimps, &c.) rank among those animals which are destitute of a back bone; and are comprehended in the division termed *Artici lata*, or animals whose members or limbs consist of segments or rings, articulated into each other, to the inside of which their muscles are attached. Chemists have found the shells of crustaceous animals to consist of phosphate of lime in combination with animal matter, while those of the testaceous mollusca are composed of lime along with the gelatinous substance. But a still more obvious distinction exists between these animals; the shells of oysters and other testaceous animals generally consist of one or two pieces, enveloping the whole animal, (except in the Cirripedes, see note on Conchology, p. 350-358) and adheres permanently during life: while the coverings of the crustacea are cast and renewed periodically, and invest the animals as it were in a coat of mail.

Linnæus placed crustacea between the fishes and mollusca, united them to his class *Insecta*. In the earlier writings of Cuvier and Latreille, they adopted the views of Linnæus, while Lamarck followed the ideas of Brisson, who formed them into a separate class, as well as spiders; giving the former the name *Crustacea* and the latter *Arachnoides*. This improvement has been generally acknowledged, and followed by subsequent writers on Natural History.

Crustaceous animals present remarkable physiological distinctions. They respire by means of branchiæ, or by branchial plates, usually attached to their feet or to their jaws; they have from five to seven pairs of feet; their head is frequently not distinct from the trunk, provided with from two to four jointed setaceous antennæ; and two compound movable eyes seated on peduncles, which are sometimes movable, and at others fixed; they have a distinct heart, and a regular circulating system: their organs of reproduction are placed either in the feet or tail.

In those genera where the head is not separated from the trunk, the shield or covering envelopes the whole thorax. In other genera the head is distinct from the body, which is divided into seven segments, to the lower sides of which the feet are attached; these for the most part have a tail, consisting of many segments. The limbs vary from ten to fourteen, each having six articulations. The two anterior limbs, and sometimes even three on each side, are provided with forceps; at other times they are terminated by simple hooks, and in many instances by appendages which fit them for swimming.

The branchiæ in crustaceous animals, unlike those of fishes, are external, although frequently concealed, and placed at the sides of the feet, limbs, or under the tail; they are, however, more frequently at the sides of the feet; and consist either of filamentary tufts, or pyramidal laminæ.

The mouth has usually two mandibles, a *labium*, or lip below, and from three to five pairs of jaws. The first, or first three pairs of these, have been termed *feet-jaws*. These small leg-shaped appendages are not fitted

for locomotion, but, being situated near the mouth, assist in the operation of feeding.

The nervous system consists of a ganglion or brain situated above and before the intestinal canal, with a continuous elongated double chord, having ganglions placed on the lower surface of the body, extending, in some instances, its whole length ; while in others, it consists of a central medullary circle, with radiated elongations.

Many of the crustaceous animals have an acute faculty of sight; a number of them also possess the senses of smell and taste; but from their shelly envelope their sense of feeling must be very blunt: while their touch must be very sensible, from the number of tentacula possessed by many of them.

Lamarck divides the Crustacea into *five* orders.

ORDER I.—DECAPODA.

The head is not distinct from the trunk; branchiæ formed like leaflets, close to the base of the four feet-jaws, and hidden under the sides of the shell.

SECTION I.—BRACHYURA.

Branchiæ, seven on each side, moving on a common axis; post-abdomen, bent underneath; generally received into a cavity beneath the præ abdomen; without a fin at the termination.

Family I.—Quadrilatera.

Thorax nearly square, frequently heart-shaped; anterior angles expanded; posterior extremity transversely truncated; front protruded, more or less inclined; none of the feet terminated by a fin. The genera of this family are Octypoda, Gelasimus, Myctris, Pinnotherel, Gecarcinus, Plagusia, Grapsus, Gonoplax, Thesphusa, and Eriphia. *Thelphusa fluviatilis*, pl. 23, fig. 1.

Family II.—Arcuata.

The shell anteriorly arched, to nearly the centre of the sides; posteriorly narrowed and truncated. The genera are, Pilumnus, Cancer, Pirimela, Atelecyclus, Podophthalmus, Lupa, Portunus, Thia, and *Portunus corrugatus*, pl. 23. f. 2.

Family III.—Orbiculata.

Orbicular, narrowed before, usually with two furrows; exterior feet-jaws with their third joint triangular. The genera are, Matuta, Orithyia, Corystes, Leucosia, and Hepatus. *Leucosia Urania*, pl. 23, f. 3.

Family IV.—Cryptopoda.

Nearly triangular; vaulted, and dilated at the posterior angles, for the feet in repose: with large, crested, and compressed forceps. The genera are, Œthra and *Calappa tuberculata*, pl. 23, f. 4.

Family V.—Trigona.

Subovoid or triangular; anterior extremity compressed and pointed; claws in the males frequently longer than in the females. The genera are, Parthenope, Eurynome, Pisa, Maia, Stenopus, Hyas, Inachus, Macropodia, Leptopodia, Pactolus, and Lithodes. *Pisa tetraodon*, pl. 23, f. 5.

Family VI.—Notopoda.

Having two or four posterior feet, inserted on the back, or somewhat above the line of the rest. The genera are, Homola, Ranina, Dromia, and *Dorippe nodulosa*, pl. 23, f. 6.

SECTION II.—MACROURA.

Bodies longer than in former section; post-abdomen carinated above; antennæ terminated by filaments.

Family I.—Hippides.

Last abdominal segment lengthened, and foliaceous; two anterior feet, tapering; frequently with a monodactylous hand; sometimes with a claw; the other six feet with their last joint fin-shaped. The genera are, Albunea, Hippa, and *Remipes testudinarius*, pl. 23, f. 7.

Family II.—Pagurii.

Shell but slightly crustaceous; two anterior feet didactyle; next four pairs with long acute tarsi; last four pairs smaller, terminating with a forceps; sometimes with a pointed hook. The genera are, Birgus, and *Pagurus laticauda*, pl. 23, f. 8.

Family III.—Palinurini.

Terminated by a fan-shaped post-abdomen, produced by the lateral appendages of the last and preceding segments. There is but one genus: *Polinurus locusta*, pl. 23, f. 9.

Family IV.—Syllarides.

Having the peduncle formed like a depressed crest. The genera are, Thenus and Scyllarus.

Family V.—Galathinæ.

Feet all alike, but the two anterior, which are didactyle. The genera are, Eryon, Magalopa, Galathea. *Porcellana platycheles*, pl. 23, f. 10.

Family VI.—Astacinæ.

Four or six of the anterior feet didactyle; terminating abdominal exterior leaflets, entire in some, and in others divided by a suture. The genera are, Thalassina, Gebia, Axius, Callianassa, Nephrops, and *Astacus Marinus*, pl. 23, f. 11.

Family VII.—Carides.

Intermediate antennæ placed above the lateral ones, protruding with two or three filamentary terminations, The genera are, Penæus, Stenopus, Alpheus, Hippolyte. Autonomea, Gnathophyllum, Hymenocera, Nika, Athanas, Atya, Egeon, Crangon, Pandalus, Pasiphæa, and *Palæmon Serratus*, pl. 23, f. 12.

Family VIII.—Schizopoda.

Feet slender, filiform, fitted for swimming only; one of them hand-shaped, but having either a long, lateral appendage, or deeply cleft, or multifid at their extremity. The genera are, Mysis, Zoea, and *Nebalia Herbstii*. pl. 23, f. 13.

ORDER II.—STOMAPODA.

The branchiæ suspended, in the form of tufts, on the lower appendages of the post-abdomen; head, distinct from the trunk, large, and separated into two parts; shell, membranaceous; intermediate antennæ with two or three filaments at their terminations; six posterior feet filiform; body terminated by a foliaceous fin.

Family I.—Unipeltata.

With an elongated and narrow body; eyes and intermediate antennæ placed on an anterior elongation of the thorax; exterior feet-jaws, and four anterior limbs, terminated by a monodactyle forceps; the other six limbs fitted for swimming, with the last joint brush-shaped; lateral antennæ having a scale at the base; intermediate ones trifilamentary. The genera are, Squilla, Erichthus, and *Alima Hyalina*, pl. 23, f. 14.

FAMILY II.—BIPELTATA.

Body depressed, membranous, and thin; thorax with twin shields; anterior, very large, oval; posterior one supporting the feet-jaws, and five pairs of transverse and angular feet; intermediate antennæ with two filaments. It has but one genus, Phyllosoma.

ORDER III.—LÆMODIPODA.

Head not distinct from the trunk; the second and third segments, having four vesicular bodies under them; antennæ four, multi-articulate; mandibles destitute of palpi; post-abdomen short.

FAMILY I.—OVALIA.

An oval body with transverse segments; limbs strong, of medium length; those of the second and third segments imperfect, with a long, cylindrical, blunt termination, each provided with an elongated vesicle at the base. It has but one genus. *Cyamus ceti*, pl. 23, f. 15.

FAMILY II.—FILIFORMIA.

With an elongated, linear body, and narrow longitudinal segments; limbs long and slender; last portion of the upper antennæ jointed. The genera are, Caprella, Proto, and Leptomera.

ORDER IV.—AMPHIPODA.

Head separate from the segment, to which the anterior feet-jaws are attached; post-abdomen provided with branchial and swimming appendages beneath. They are narrow, lengthened, and multi-articulate, transversely striated, or branched; mandibles provided with palpi; some of the feet having vesicles.

FAMILY I.—GAMMARINÆ.

Body posteriorly furnished with cylindrical or conical styliform appendages, or with none in some genera. The genera are Cerapus, Melita, Amphithoe, Dexamine, Gammarus, Pherusa, Orchestia, Talirus, Atylus, Corophium, Podocerus, Jassa, Phronima, and *Leucothoe articulosa*, pl. 23, f. 16.

FAMILY II.—UROPTERA.

Lateral appendages at the posterior extremity of the body, in the form of leaflets, and acting as fins. The genera are Hyperia and Phrosine.

FAMILY III.—DECEMPEDES.

Animals provided with ten feet only. The genera are Typhis, Anceus, and Praniza.

FAMILY IV.—HETEROPA.

With fourteen feet, in most instances all fitted for swimming on the four last only. The genera are, Ione, and *Apseude talpas*, pl. 23, f. 17.

ORDER V.—ISOPODA.

Having a distinct head; mandibles devoid of palpi; three pairs of jaws, the lower ones appearing like two small feet united at their base, or a lip having two palpi; body somewhat depressed, divided into from three to seven segments; feet ten or fourteen; tail varying from one to nine segments, with branchials; destitute of shell; eyes granulated; antennæ generally four.

SECTION I.—AQUATICA.

Antennæ four, anterior with three or four joints; sometimes without antennæ; lower appendages of post-abdomen usually vesicular, having no openings for the entrance of air.

FAMILY I.—EPICARIDES.

Body much depressed above, and concave below, having neither eyes, antennæ, mandibles, nor caudal fin. But one genus, Bopyrus.

FAMILY II.—CYMOTHOADES.

Eyes and antennæ four, sometimes indistinct; mandibles horny; feet fitted for walking and prehension; posterior extremity with a fin on each side: post abdomen with four or six segments. The genera are, Cymothoe, Cirolana, Eurydice, Nelocira, Limnoria, Serolis, and *Ægа Marginata*, pl. 23, f. 18.

FAMILY III.—SPHÆROMIDES.

Post-abdomen with three segments, the last with two leaflets. The genera are, Zuzara, Sphœroma, Campecopea, Næsa, Dynamene, Cymodocea, and *Anthura gracilis*, pl. 23, f. 19.

FAMILY IV.—ASELLOTA.

Last abdominal segment devoid of swimming appendages. The genera are, Asellus, Janira, and Jæra.

FAMILY V.—IDOTEIDES.

Branchial appendages situated under the post-abdomen, covered by the valves of the last segment; four antennæ in a transverse line, lateral ones with a filamentous termination: post-abdomen of three segments. The genera are, Idotea, and *Stenosoma lineare*, pl. 23, f. 20.

SECTION II.—TERRESTRIA.

The two intermediate antennæ hardly visible, one or two jointed; post-abdomen of six segments; posterior margin of the last with two or four cleft styles.

FAMILY VI.—ONISCIDES.

Consisting of the true Oniscæ. The genera are, Ligia, Philoscia, Oniscus, Porcellio, and *Armadillo Vulgaris*, pl. 23, f. 21.

ORDER VI.—LOPHYROPODA.

Head not distinct from the trunk; eye, or eyes, compound and sessile; shell sometimes of two pieces, usually large; no palpi on the mandibles; jaws destitute of branchiæ; feet variable in number, fitted for swimming, simple, or branched, or formed of hairy laminæ, organs of respiration supposed to be situated in them.

FAMILY I.—UNIVALVIA.

Shell in one piece, the most part of the body being uncovered. *Cyclops quadricornis*, pl. 23. f. 22.

FAMILY II.—OSTRACODA.

Shell either folded in two, or in the form of two valves united by a hinge, and enveloping the body. The genera are Polyphemus, Daphnia, Lynceus, Ceytherina, and *Cypris ornata*, pl. 23, f. 23.

ORDER VII.—PHYLLOPODA.

Head not distinct from the trunk; eyes sessile, smooth, and approximate; antennæ very short; shield crustaceous, free behind; mandibles two; destitute of palpi; the first pair of feet oar-shaped, the other sixty set in pairs, and fitted for swimming.

FAMILY I.—ASPIDIPHORA.

Eyes not placed on peduncles. The genera are, Limnadia and Apus.

FAMILY II.—CERATOPHTHALMA.

Having no shell, and the eyes seated on peduncles. The genera are, Artemia and *Branchipus stagnalis*, pl. 23, f. 24.

ORDER VIII.—XYPHOSURA.

Body in two parts; without a siphon; base of the feet, except the last, spinous, which serve as jaws; with a hard twin shell covering the whole body, having longitudinal furrows above; termination of the body sabre-shaped. This order consists of but one species, Limulus Polyphemus.

ORDER IX.—SIPHONOSTOMA.

Family I.—Caligides.

Body somewhat oval, with a distinct shell. The genera are *Argulus*, Caligus, Cecrops, and *Anthosoma Smithii*, pl. 23, f. 25.

Family II.—Lernæiformes.

Destitute of shell; body nearly cylindrical, jointed, and worm-shaped. This family consists but of one species, Dichelesthium Sturionis. Many fossil species have been found, which naturalists refer to existing genera.

Anatomy of a Plagusia.—Order I. Family I. Pl. 30, f. 31, head; *a*, *a*, eyes; f. 32, an eye seated on its pedicle; f. 35, tail; f. 29 and 34, teeth; f. 38 and 30, antennæ; f. 27, post abdomen; f. 26, internal structure of thorax; f. 33, internal structure of abdomen.

MOLLUSCOUS ANIMALS.

Molluscous Animals, like crustacea, are comprehended in the second great division of the animal kingdom—animals without a backbone. They are destitute of an articulated skeleton or vertebral column. The nervous system is not developed in the form of a spinal cord, but simply into a certain number of medulary masses situated in different points of the body, the principal of which is called the brain, and is placed transversely on the œsophagus, and envelopes it with a nervous collar. The organs of sensation and motion have not the same uniformity in point of number and position as in the vertebrate animals, and a greater aberration is observable in the position of the heart and organs of respiration, as well as in the structure of the latter. Some species are formed for breathing elastic air, and others fresh or salt water. Their organs of locomotion, and others, which are external, are generally symmetrically arranged on the two sides of an axis.

The mollusca have a double circulation, their pulmonary system invariably describing a distinct circle. The function of breathing is always assisted by, at least, one ventrical, situated between the pulmonary veins and the arteries of the body and not, as in fishes, between the veins of the body and pulmonary arteries. It is then an aortic ventrical. It is only the cephalopoda[1] that are provided with a pulmonary ventrical, which is subdivided. The aortic ventrical is likewise divided in some genera, as in the arca[2] and lingula.[3] In some other bivalves, the auricle only is divided. When more than one ventrical exists, they do not consist of a single mass, as in warm-blooded animals, but are remote from each other.

The blood in molluscous animals is white, or bluish-white, and seems to contain a smaller proportion of fibrin than that of vertebrate animals. Cuvier supposes that the veins perform the functions of absorbent vessels.

The muscles in this class are attached to their skin by various points, forming, in those places, tissues which possess more or less density. Their motions consist of different contractions, varying in their direction, producing inflections and prolongations, together with relaxations of their several parts, by means of which they creep, swim, and seize upon such objects as the formation of these parts are adapted to. They are, however, incapable of rapid progress, their limbs not being supported by articulated and solid levers.

Most of the mollusca are possessed of great irritability, frequently continuing after they are cut asunder. Their skin is naked, extremely sensible, and usually covered with a mucous substance, which is secreted from its pores. No organ of smell has yet been detected in them, although they appear to possess that sense. Cuvier thinks it probable that the whole skin may be susceptible of distinguishing odours. All the *cephala*, *brachiopoda*, *cirripeda*, and part of the *gasteropoda*, and *pteropoda* are destitute of eyes, while the *cephalopoda* enjoy them in as complicated a degree as the warm-blooded animals. The eyes are situated sometimes at the base, sometimes at the middle, and frequently at the extremity of the tentacula. The cephalopoda are the only ones in which have been discovered the organ of hearing, and where the brain is enveloped in a kind of case, of a cartilaginous consistence.

Almost all molluscous animals have a peculiar development of the skin, which covers their body, like a *mantle*, and has received that appellation. This process, however, is sometimes narrowed into a simple disk, or is tubiform, or hollowed into a sac, and in some cases it is divided and extended in the shape of fins. There are two distinct kinds of molluscous animals, namely, cephalous, or such as are provided with a head, and acephalous, or destitute of a head. These are again distinguished by such as are *naked* mollusca and *testaceous* mollusca, or with a shelly envelop. The naked mollusca have a membranous or fleshy mantle; which, however, has frequently one or more hard laminæ in its texture. These are increased in dimensions and thickness, by a deposit of earthy and animal matter combined; the new layers overlapping the old ones. When this substance remains concealed

[1] See note on Conchology, in the present volume, Class I., Order II., p. 354.
[2] Ib. Class II., Order II., p. 355.
[3] Ib. Order I., p. 355.

within the tissue of the mantle, the animals are called naked mollusca. The common field-snail, (*Limax agrestis*, pl. 24, f. 5.) and the black-snail, (*L. ater*, pl. 27, f. 25.) are examples of animals of this kind. More frequently however, this shelly matter becomes so greatly developed that the animal, in a state of repose, can contract itself within it; it is then termed a *shell*, or a *testaceous* animal, which is exemplified by the common garden snail-shell. (*Helix aspersa*, pl. 24, f. 15.) The epidermis which covers these animals, is very thin and sometimes dessicated, or of a woolly texture.

The variety of forms, surface, colour, brilliancy, and substance is almost infinite. They are nearly all calcareous, although some are simply of a horny consistence; but in both cases they consist of matter deposited in layers, or exuded from the skin under the epidermis, in the same manner as the hardened mucous covering, nails, hairs, horns, scales, and even teeth. The shelly tissue differs according as its transudation is deposited, either in parallel laminæ, or in close set vertical filaments.

Every mode of mastication and deglutition is illustrated in the mollusca; for we find their stomachs simple, complicated, and frequently provided with a peculiar armature; the alimentary canal is variously prolonged. Most species have salivary glands, and always a liver, but neither pancreas nor mesentery. Several have peculiar secretions.

Several of the mollusca are bisexual. Some produce their young alive, while others are oviparous. The eggs in some are covered by a shelly envelop, and others only by a simple viscosity.

The turbinated mollusca appear to be animals in a slight state of development; they possess but little industry, and are only preserved by their great fecundity, and extreme tenacity of life. They are all oviparous; their reproduction consequently depending on sexual impregnation.

Some genera of mollusca inhabit the sea and fresh waters, while others are entirely terrestrial: and a few species are amphibious, as may be exemplified in the *succinea, amphibia*, pl. 31, f. 75.

They feed on all substances, both animal and vegetable; some will eat these even in a putrid state, while others will only consume them fresh.

The uses of this numerous class are extremely varied. Many of them are taken as food by man, and others supply nutritious prey for birds and fishes. Their shelly coverings are converted into many useful articles of commerce; and from the veins of certain species of shells called *purpura*, is extracted the beautiful dye of the ancients called Tyrian purple. The *P. lapillus*, which is common on the British shores, adhering to stones, yields this dye; it is represented in pl. 24, f. 79. For a description and figures of the different parts of testaceous mollusca, see the note on Conchology, in this volume, p. 350—358.

CLASS I.

CEPHALOUS MOLLUSCA, OR SOFT ANIMALS WITH A HEAD.

Lamarck divides the turbinated testaceous mollusca into five orders, depending upon the complication of their internal organization. These are first:—

ORDER I.—HETEROPODA.

Destitute of arms arranged around the head; unprovided with a foot under the belly or throat for locomotion, but furnished with one or more irregularly set fins.

The animals of this order are distinguished from all the other mollusca by the form of their foot, which, in place of a horizontal disk, is compressed into a circular lamina, and is used as a fin, and on the edge of which, in several species, is a dilatation forming a hollow cone, representing the disk of the other orders. Their branchiæ are situated on the posterior part of the back, and composed of plumiform lobes, directed forward; immediately behind these are the heart, a small liver, with part of the viscera and internal organs of generation. Their bodies are of a gelatinous, transparent substance, lined with a muscular layer, elongated, and terminated by a compressed tail, in most species. There is a muscular mass belonging to the mouth, and the tongue is provided with little hooks; the œsophagus is very long; the stomach thin; on the right side of the visceral mass are two prominent tubes affording a passage for the fæces, ova, &c. They generally swim on their back, with the foot upwards. They possess the property of distending their body by filling it with water, in a way which is not yet properly understood. *Carnaria Cymbium*, pl. 31, f. 1.

ORDER II.—CEPHALOPODA.

Lower part of the body enveloped in a bag-shaped mantle, with the head issuing from the sac, and having inarticulated arms, to which are attached cups, surrounding the mouth of the animal, which is furnished with two horny mandibles. The mantle unites under the body; in several species the sides are extended into fleshy fins: head projecting from the sac, is provided with two large eyes, and crowned with longer or shorter fleshy arms or feet, capable of motion in all directions, their surface provided with cup-shaped suckers, by means of which they can adhere firmly to other bodies; these feet are used for prehension, natation, and walking. They swim with the head behind, and crawl in all directions, with the head under the body. At the opening of the sac in front of the neck, is placed a fleshy funnel as a passage to the excretions. See the note on Conchology, p. 350—358.

Division I.—Cephalopoda Sepiaria.

Loligo vulgaris. Medium cuttle-fish, pl. 27, f. 6.

Division II.—Cephalopoda Monothalama.

Shell unilocular, entirely external, and enveloping the animal. *Argonauta Argo.* Paper Nautilus, pl. 31, f. 2. and pl. 24, f. 1.

Division III.—Cephalopoda Polythalama.

FAMILY I.—AMMONACEA.

Septa sinuous, lobed and cut at the margin, meeting together upon the inner wall of the shell, and articulated by jagged sutures. Shell multilocular, partly or

entirely internal, and inserted in the posterior part of the body.

All the species of this division are fossil. See the note on Organic Remains, vol. i. p. 22.

FAMILY II.—NAUTILACEA.

Shell discoform, with a central spine, and short cells, which do not extend from the centre of the circumference.

Nautilus Pompilius, pl. 31, f. 3, and pl. 24, f. 63. The other genera are fossil. See the note on Organic Remains.

FAMILY III.—RADIOLACEA.

All the genera are fossil. See the Note on Organic Remains, vol. i. p. 22—27.

FAMILY IV.—SPHERULACEA.

Fossil, except one species found near Corsica, which is so minute that the animal has not been ascertained. See as above.

FAMILY V.—CRISTACEA.

All the species are fossil. See as above.

FAMILY VI.—LITUOLACEA.

Shell partially spiral; the last volution continued in a straight line. *Spirula Peronii*, pl. 31, f. 4. Animal a cephalopode, pl. 24, f. 2. The body or that part which inhabits the shell, *a*.

FAMILY VII.—ORTHOCERATA.

Animals of the genera unknown. See the Note on Conchology, p. 350—358.

ORDER III.—TRACHELIPODA.

Body usually spirally convoluted, and separated from the foot, which is free, flat, and attached to the neck at its base for the purpose of locomotion; the body always enveloped by a spiral shell.

SECTION I.—ZOOPHAGOUS TRACHELIPODA.

FAMILY I.—INVOLUTA.

Shell destitute of a canal, but with the base of its aperture notched or effuse, and its volutions broad, compressed, and rolled up in such a manner, that the last nearly covers all the others. *Conus generalis*, pl. 24. f. 3. *Cypræa Europea*, pl. 24. f. 8. *Buccinum undatum*, pl. 24, f. 19, 20. The extracted animal; *a a*, the foot; *b*, the head; *c*, a kind of platform raised above the thoracic cavity, on which the point of the boring trunk rests. This organ is represented at f. 31, 32, and 33. *d, d, d*, the cavity of the thorax; *e*, the mantle; *f*, the rectum; *g*, the stomach; *h*, the heart, thrown below, and to the right side of its natural situation, to allow the opening of the tube to be seen; *i*, the respiratory trunk; *k*, the organs of the muscles of the boring trunk; *l*, the course of the tube by which the foot is supplied with water; *m*, its termination; f. 34, magnified representation of the stomach and alimentary tubes; *a*, the throat; *b*, the outer coating; *c*, the alimentary canal; *d*, the opening from the stomach.

FAMILY II.—COLUMELLARIA.

No canal at the base of the aperture, but a subdorsal notch more or less apparent, and a fold upon the columella. *Voluta scapha*, pl. 31, f. 14. The animal has a large thick and fleshy foot, and the head is provided with a vail, from the sides of which issue the tentacula: the proboscis is rather long, and there is an appendage on each side of the base of the siphon. When the proboscis is extended, it can bend in all directions, by means of the retractor muscles, acting with opposing forces. This interesting mechanism is illustrated by f. 32, wherein the proboscis is represented retracted about a half; the external cylinder, *a*, is seen enveloping a portion of the inner one, *b*, the point of which *c* is the termination of the proboscis; the muscles which draw it within the body, *d d*, are in a state of contraction, and at *e* is represented the great annular muscle, which pushes forward the inner cylinder, and consequently lengthens the organ.

FAMILY III.—PURPURIFERA.

Shell with a short canal ascending posteriorly, or with an oblique notch at the base of its aperture, directed backwards. They are all operculate. *Purpura lapillus*, pl. 24, f. 79.

FAMILY IV.—ALATA.

Shell with a greater or less canal at the base of the aperture, of which the right lip changes its form as the animal advances in age, and has a sinus at the lower part. *Strombus Succinctus.*

FAMILY V.—CANALIFERA.

Shell with a canal more or less long at the base of the aperture, and of which the right margin does not change its form as the animal advances in age. *Murex acanthopterus*, pl. 31, f. 32.

SECTION II.—PHYTIPHAGA.

Destitute of projecting siphon, and respiring generally by an orifice, furnished with jaws, and feeding on vegetables, shell with the aperture entire, and without any notch or canal. Many of the species live upon land, and respire air, while others inhabit fresh water, either stagnant or running. Many are marine. Some families are furnished with an operculum attached to the foot of the animal.

FAMILY I.—TURBINACEA.

Shell turreted or conoid, having an oblong or rounded aperture, not widened, and the margin disunited. *Turbo smaragdus*, pl. 31, f. 45. *Turbo littoreus*, pl. 24, f. 13.

FAMILY II.—SCALARIDES.

Shell devoid of plicæ or folds on the columella; the margins of the aperture are united in circular forms. *Scalaria coronata*, pl. 31, f. 51.

FAMILY III.—PLICACEA.

Shell with the aperture not widened, and folds on the columella. *Tornatella flammid*, pl. 31, f. 54.

FAMILY IV.—MACROSTOMA.

Shell auriform, with the aperture very wide, and the margins disunited; destitute of columella and operculum. *Haliotis tuberculata*, pl. 31, f. 55, and pl. 24, f. 12. *Sigaretus Haliotoideus*, pl. 24, f. 42. Shell concealed in the mantle; *m*, the membranous shield under which the shell is concealed; *n*, a sinus through which an arm is sometimes protruded; *o*, the tentacula, at the base of which the eyes are placed.

FAMILY V.—IANTHENIA.

Shell gibbous, conoidal, thin, transparent, aperture triangular, columella straight, surpassing the base of the right margin; destitute of an operculum. *Ianthena exigua*, pl. 31, f. 59.

FAMILY VI.—NERITACEA.

Shells semiglobular or oval, destitute of a columella, and the left margin edged and transverse, provided with an operculum; inhabit fresh waters and the sea.

Natica monilifera, pl. 24, f. 35. A front view, with tentacular head and mantle reflected; *c*, the head; f. 37, a view of the head from beneath; f. 38, one of the cartilaginous jaws. *Neritina fluviatilis*, pl. 24, f. 18.

FAMILY VII.—PERISTOMIDA.

Shell conoid or sub-conoid with an operculum, and the margins of the aperture united. All the species

are fluviatile, the animals respiring in water. *Paludina impura*, pl. 24, f. 11. *Valvata piscinalis*, pl. 24. f. 61.

FAMILY VIII.—MELANIDES.

The margins of the aperture disunited, and the right one edged; animal provided with two tentacula. *Pirena Madagascarensis*, pl. 31, f. 67.

FAMILY IX.—LYMNÆCEA.

With an oblong acutely tapering spire, generally smooth on the external surface, and having the outer margin of the aperture always acutely edged, and not reflected. Animal amphibious, generally destitute of an operculum, and the tentacula flattened. *Lymnæa stagnalis*, pl. 24, f. 4.

FAMILY X.—COLIMACEA.

Shells acutely spiral, with no projecting parts on their exterior, except the markings of their periodical additions; the right margin of the aperture frequently reflected outwards; the tentacula are cylindrical, and usually four in number, but two in others, and destitute of operculum. They are terrestrial animals. *Cyclostoma elegans*, pl. 24, f. 10. *Succinea amphibia*, pl. 24, f. 58. *Pupa sexdentatus*, pl. 24, f. 57. *Helix aspersa*, pl. 24. f. 15; f. 92, apparatus of vision in *Helix Pomatea;* f. 65, toothed cartilage of do.

ORDER IV.—GASTEROPODA.

Body never spiral, destitute of any shell, provided with a muscular foot attached its whole length under the belly, for the purpose of locomotion. Some of the animals of this division are naked and destitute of any calcareous covering, others are provided with a dorsal plate, and a third series have a shell which is more or less concealed in their mantle. The animals of this order are limited by Lamarck to those whose bodies are straight, and never spirally convoluted, and which are provided with a muscular disk or foot, united to the body nearly its whole length. F. 66, pl. 24, exhibits the nervous system of the *Aplysia;* f. 67,* *Clio Borealis;* f. 67, the same in the act of swimming.

SECTION I.—PNEUMOBRANCHIÆ.

Branchiæ in the form of a vascular net on the wall of a particular cavity, opening by a hole, which the animal contracts and dilates at pleasure.

FAMILY I.—LIMACINÆ.

Branchiæ in the form of a vascular net on the partition of a particular cavity, the aperture of which the animal can contract or dilate at pleasure. The body of the animals is elongated, and they crawl by means of a ventral disk bordered on the sides by a very narrow mantle. *Vitrina beryllina*, pl. 24, f. 7. *Testacella Scutulum*, pl. 24, f. 6. *Limax ater*, pl. 27, f. 25. *Onhidium Typha*, pl. 27, f. 7.

SECTION II.—HYDROBRANCHIÆ.

FAMILY III.—LAPHYSIACEA.

The branchiæ are situated in a particular cavity towards the posterior part of the back, and covered by an opercular scutellum; they are provided with tentacula. The animals of this family resemble large snails, but have a thicker body, and are broader towards the posterior part, and have a larger margin to their mantle; the head projects, and is provided with four tentacula, two of which are placed near the mouth, and the other two more behind. The branchial scutellum is corneous or cretaceous. *Dolabella callosa*, pl. 31, f. 88. *Laphysia deplians*, pl. 27, f. 8, pl. 24. f. 17.

FAMILY III.—BULLACEA.

Head very distinct: the branchiæ are situate in a particular cavity, towards the posterior region of the back, and covered by a mantle; they are destitute of tentacula, and branchial operculum. Some species are unprovided with either exterior or interior shell, and in others the shell is completely concealed in the mantle, and there are several which have an external shell attached by a muscle. *Bulla hydatis*, pl. 24, f. 86. This figure exhibits the back of the shell, with the lateral fin-like membranes protruded *a*. F. 87. The gizzard magnified. *a, a, a*, the tips of the plates covered by a thin membrane, and surrounding a muscular integument, thickened at the upper part *b;* the part attached to the mouth *c*, with the œsophagus communicating with the gizzard; *d*, the intestinal canal. F. 88. The gizzard laid open at its anterior end, showing the three corrugated corneous plates *e, e, e*, with their connecting ligaments *f*, magnified. *Bulla aperta*, pl. 24, f. 83 and 68. Lateral lobes of the foot thickened and reflected upwards; head indistinct; destitute of tentacula; branchiæ dorsal; shell concealed in the mantle, *a*. F. 84, the gizzard composed of three testaceous plates, showing the smaller plate *b*, with the connecting ligament *c*. F. 85, another view of the gizzard, showing the two larger plates *d d*, with their connecting ligaments; *e*, the gullet, *f*, the alimentary canal.

FAMILY IV.—CALYPTRACEA.

The branchiæ are situate in a cavity on the back near the neck, and projecting beyond or included in the cavity; shell always placed exteriorly *Ancylus fluviatilis*, pl. 24, f. 9.

FAMILY V.—SEMIPHYLLIDIACEA.

The branchiæ are situated under the margin of the mantle, and disposed in a longitudinal series on the right side of the body; respiring in water. *Pleurobranchus plumula*, pl. 24, f. 14, f. 22. Alimentary canal; *a* the first stomach; *c* the second stomach; *d* the third stomach; *e* the fourth stomach. The œsophagus dilates into a membranous crop *a;* at the lower part of which, *b*, the bile is poured in. It communicates by a narrow cardia with the second stomach *c*, which is a gizzard with thin but muscular parietes. The third stomach *d*, is membranous, and precisely resembles the plicated stomach of ruminants, in being disposed in large but delicate folds, by means of which the alimentary matter contained in it is moulded into long whitish cords. The fourth stomach *e*, is membranous, like the crop, but smaller. It is remarkable that the gizzard contains a narrow groove, running through its whole length, leading from the first to the fourth stomach, and probably subservient to a species of rumination. F. 44. Another view of the animal; *g*, its protracted foramen; *h h*, the lower lamina, or border of the sustentaculum; *i*, the upper lamina, under the middle of which the shell is concealed; *k*, a plumose feeler; *l*, the tentacula, at the base of which the eyes are placed.

FAMILY VI.—PHYLLIDIACEA.

The branchiæ are situate under the margin of the mantle, and disposed in a longitudinal series around the body. The animals all respire in water. *Patella vulgata*, pl. 24, f. 21. F. 23. The alimentary canal. *a*, the mouth; *b*, the buccal mass; *c*, the tongue; *d*, the stomach; *e e*, the intestine. F. 24, represents the tongue of the patella of its natural size; f. 25, is a portion magnified; f. 26, 27, and 28, are the cartilaginous jaws. *Chiton cinereus*, pl. 24, f. 78. F. 93. The animal extracted. *a a*, the ventre; *c c c*, the intestinal canal; *e*, the anal opening; *d d d d*, the liver; *f*, the ovarium.

FAMILY VII.—TRITONIACEA.

The branchiæ are placed exteriorly, and situated above the mantle on the sides or on the back. The animals respire in water. The animals of this family are distinguished from those of the other Gasteropoda, by the situation of their branchiæ, which are all exterior; in several genera these appear to be a degeneration of the mantle, or to be formed by portions of it having become branchial; the body is always destitute of a shelly covering, and neither have they one internally. All the animals inhabit the sea. *Doris argus*, pl. 27, f. 9. *Tethys leporina*, pl. 24, f. 30. The alimentary canal. *a*, the proboscis; *b*, the œsophagus; *c*, the stomach; *d*, the intestine; *e*, the hepatic duct; *f*, the liver; *g*, the hepatic artery; *h h*, salivary glands—the parts are laid open; f. 29. the horny jaws of a *Tritonia*.

ORDER V.—PTEROPODA.

Destitute of any shell, foot or arms, either for locomotion or seizing their prey; but provided with two opposite and similar fins, fitted for swimming. The animals of this order are provided with two opposite fins; they are mostly of a small size, and either destitute of appendages, or having very short ones, situate at the head; some species are provided with a thin cartilaginous or horny shell. *Hyalæa tridentata*, pl. 24, f. 36.

CLASS II.

ACEPHALOUS MOLLUSCA, OR SOFT ANIMALS DESTITUTE OF A HEAD.

The second great division of testaceous Mollusca, consists of animals which are destitute of any apparent head, and have been denominated by Lamarck, Conchifera. Their mouth is concealed in the bottom, or between the folds of their mantle, which is usually doubled and incloses the body, in the same manner as a book is clasped over by its cover; but it often happens, that, in consequence of the two lobes uniting before, it forms a tube; sometimes it is closed at one end, and then it represents a sac. The mantle is generally covered by a calcareous, testaceous bivalve shell united by a hinge or ligament, and in some instances the shell is multivalve; in two genera, however, it is only of a cartilaginous or membranaceous nature. The animal is always attached to this shelly covering by strong muscles, by means of which it can open or close the sides of its covering at pleasure. The brain is situated over the mouth, where one or two other ganglia are observable. The branchiæ or gills, generally consist of large lamellæ covered with vascular meshes, under or between which passes the water; and are more simple in those genera which are destitute of a shell. The leaflets of which the branchiæ are composed are generally crescent-shaped, placed on each side of the cloak, covering the abdomen of the animal upon the sides of which they are attached in pairs; they are formed of a tissue of small vessels arranged close together, like the pipes of an organ. From these branchiæ the blood proceeds to the heart, which is placed towards the back, is very small, but provided with venous and arterial vessels. The liver is extensive, and embraces the stomach and the greater proportion of the alimentary canal. The mouth is always devoid of teeth, and is capable of only receiving the molecules, conducted to it by the water; at each side of the mouth are four thin triangular leaflets, which are the extremities of the lips. Some species are provided with two stomachs. The whole animals of this division fecundate themselves, and in many of the species, the young ones are extremely numerous, and pass some time in the thickness of the branchiæ before quitting the parent. The whole acephala are aquatic animals. The foot of the animal when it exists is a mere fleshy mass, the motions of which are effected by a mechanism analogous to that which acts on the tongue of the mammalia.

The Conchifera of Lamarck are separated into two orders as follows:—

ORDER I.—MONOMYARIA.

With but one internal muscle of attachment, and the shell marked interiorly with one subcentral muscular impression.

SECTION I.

Ligament none, or at least unknown, or replaced by a tendinous cord, which supports the shell.

Family I.—Brachiopoda.

With two opposite ciliated arms, placed near the mouth, rolled up in a spiral form when the animal is in a state of repose; mantle provided with two separate lobes before, which envelope the body. Shell bivalve, adhering directly, or by means of a tendinous cord, to marine substances. *Lingula anatina*, pl. 32, f. 1.

Family II.—Rudista.

Nothing is known of the animal, nor of the ligament and hinge of the shell; the valves are very unequal; and no distinct hooks are visible. *Crania personata*, pl. 24, f. 75.

SECTION II.

Ligament not marginal, but inclosed in a hollow space under the beak, always perceptible, and never forming a tendinous cord under the shell.

Family I.—Ostracea.

Ligament interior, or at least partly so; shell irregular, foliaceous, and sometimes papyraceous. The animal has neither foot, arm, nor projecting siphon. *Anomia ephippium*, pl. 24, f. 41. *Ostrea Edulis*, the Edible oyster, pl. 24, f. 73. f. 98, muscle of the oyster.

Family II.—Pectenides.

Ligament either interior, or partly so, being discoverable in some through an opening in the joint; shell in general regular, compact, and not foliaceous. Some genera fix themselves to marine bodies, by a byssus, while in others the lower valve is immovably attached; and many of the pectens are at liberty. *Spondylus gæderopus*, pl. 24, f. 52. *d e*, the branchiæ; *b*, the mouth; *g h i*, the abdomen; *k*, the great adductor muscle. *Pecten Jacobæus*, pl. 24, f. 77. *a b c d*, the two lobes of the mouth; *e e*, the byssus; *f f*, the abdomen; *z*, the intestinal canal; *g*, the mouth, ornamented with a fringe; *h*, the great adductor muscle. The animals of this genus possess considerable powers of locomotion, which was well known at the time Aristotle wrote. They have the power of removing themselves from one place to another, on dry land, by successive leaps. This has been fully established by recent experiments. A basket filled with the *Pecten opercularis*, or common edible scallop, has been placed on the sea shore, near the edge of the water, when all the individuals have speedily found their way to the sea. *Lima squamosa*, pl. 24, f. 72.

SECTION III.

Ligament marginal and elongated.

Family I.—Malleacea.

Ligament marginal, sublinear, and either simple or interrupted by crenulations; shell foliaceous or more or less inequivalve. *Avicula Tarentina*, pl. 24, f. 90. *a b c d*, the mantle, the duplicate of which contains the

ovarium, *f f g g*; the byssus, *h i*; the abdomen, *k*; *s*, the anal opening.

FAMILY II.—MYTILACEA.

Hinge with a sub-interior ligament, which is marginal, linear, and very entire, occupying a great part of the anterior border; shell but seldom foliaceous. Nearly the whole of this family attach themselves to marine bodies by a byssus. They have a tongue-shaped foot, by the aid of which they attach their byssus to extraneous substances. *Pinna nobilis*, pl. 24, f. 91. *a, b, c, d*, lobes of the mantle: *g g, h h*, adductor muscles; *x f*, part of the abdomen. *Mytilis edulis*, pl. 24, f. 71. f. 76, the animal.

FAMILY III.—TRIDACNITES.

The shell is transversely equivalve, with the muscular impressions situated under the middle of the upper margin, and prolonged on each side; the mantle is close and perforated by three holes, through one of which passes the foot; the second furnishes an entrance and exit for the water requisite for respiration; and the third is a passage for the excretions; the two latter not being prolonged into tubes as in the Mytilacea. *Tridacna gigas*, pl. 24, f. 64. The tendinous byssus by which these gigantic shells—sometimes weighing 300 pounds—attach themselves to rocks, is so thick and strong that an axe is required to sever it. Nearly allied to this species is *Tridacna squamosa*, pl. 32, f. 27.

ORDER II.—DIMYAIRA.

Shell having two distinct and lateral muscular impressions, which are deep and widely separated, being placed near the lateral extremities of the valves.

SECTION I.

Shell always inequivalve and irregular.

FAMILY I.—CHAMACEA.

Shell inequivalve, irregular, and adherent; with two separate muscular impressions; ligament placed externally; the animal provided with short, separate siphons, *Chama gryphoides*, pl. 24, f. 54. *Chama antiquata*, pl. 24. f. 55. *a b*, the lobes of the mantle; *c*, the abdomen; *d d*, the foot.

SECTION II.—LAMELLIPEDES.

FAMILY I.—NAYADES.

This family consists of fresh water shells; the hinge sometimes provided with an irregular, simple, or cleft tooth, and a longitudinal prolonged one; sometimes destitute of any; or is furnished in its whole length with irregular granular tubercles; the posterior muscular impression compound; and the umbones often decorticated; the muscular impressions are lateral and distant, that of the posterior side being composed of two or three distinct, unequal impressions; the animal is destitute of any projecting tube or siphon; the foot is elongated, transverse, and rounded, which it protrudes between the valves, and uses to change its position. *Anadonta cygnea*, pl. 24, f. 43. *a*, the mouth, into which a bristle has been introduced; *b*, the stomach, under which the intestine makes five turns in the foot amidst the ovary, and then as it returns, runs posteriorly along the back of the animal beneath the hinge, and above the respiratory organs, passing through the midst of the heart, *c*, and opening at *d* above the posterior muscle closing the shells, beneath the small tube of the cloak. This description applies generally to most trivalves, but in the oyster the rectum does not pass through the heart. *Unio pictorum*, pl. 24, f. 49.

FAMILY II.—TRIGONACEA.

Primary teeth of the shell lamelliform, and striated transversely; ligament exterior. *Castalia ambigua*, pl. 32, f. 35.

FAMILY III.—ARCACEA.

Primary teeth of the shell small, numerous, and disposed in a line on each valve of the shell, either in a straight or interrupted series. The valves do not close perfectly in the centre, in consequence of having a horny plate or fillet placed before the abdomen of the animal, that serves as a foot, and by which it adheres to submerged bodies. *Arca Noæ*, pl. 24, f. 59. *Arca barbata*, pl. 24, f. 70. *a*, the foot. *Pectunculus Pilosus*, pl. 24, f. 56. f. 74, animal of do.

FAMILY IV.—CARDIACEA.

Primary teeth of the shell irregular, both in their form and situation, and having generally one or two lateral teeth. In the animal, the mantle is open before, and there are besides, two separate apertures, one for respiration and the other for the fæces, which are prolonged in tubes, sometimes distinct, and at others united in one single mass. There is always a transverse muscle at each extremity, and a foot generally used for locomotion. Those which are provided with long tubes always live in ooze or sand. *Isocardia cor*, pl. 24, f. 98. *Cardium rusticum*, pl. 24, f. 60. *a e*, the tracheæ; *a*, part of the abdomen; *b b*, the branchiæ; *c*, the adductor muscle.

FAMILY V.—CONCHACEA.

Shell with three primary teeth, at least in one valve, and the other with a similar number, or less in some species; sometimes provided with lateral teeth. The animal has generally two tubes or siphons projecting from its mantle, one of which answers the purpose of a passage for the water to the branchiæ, and the other for dejected matters; the foot is lamelliform. All the animals of this family inhabit sand or mud.

Subdivision I. Generally destitute of lateral teeth; inhabiting the ocean; siphons of the animal elongated and unequal; the foot broad and projecting. *Venus Verrucosa*, pl. 24, f. 39. *Cytherea Chione*, pl. 24, f. 48. *Artemis orbiculata*, pl. 24, f. 53.

Subdivision II. Fresh water shells covered with a spurious epidermis, and having lateral teeth. *Cyclas cornea*, pl. 24, f. 50. *Piscidium obliquum*, pl. 24. f. 51.

SECTION III.—TENUIPEDES.

FAMILY I.—NYMPHACEA.

Shell never having more than two primary teeth in each valve; frequently gaping at its lateral extremities; ligament exterior. The foot of the animal is small, and often compressed; the species all inhabit the shores of the sea. *Donax trunculus*, pl. 24, f. 46. The animal has two long slender tubes, which are received into a sinus of the mantle; and provided with a broad foot. F. 47. The right valve removed. *a a*, the adductor muscles; A the foot; *s s*, the right lip; *m n*, the two lobes of the branchiæ; *b d, c e*, the two tracheæ; the left vein is at *i*. *Tellina planata*, pl. 24, f. 97.

FAMILY II.—LITHOPHAGI.

The shells gape more or less at their anterior side; ligament exterior; they bore into rocks and clay, without the aid of accessory shells, but by what means naturalists have not yet discovered. *Venerupis irus*, pl. 24 f. 69.

FAMILY III.—CORBULACEA.

Shell inequivalve, with the ligament placed interiorly. *Pandora rostrata*, pl. 32, f. 72.

FAMILY IV.—MACTRACEA.

Shell equivalve, frequently gaping at the lateral extremities; ligament placed interiorly, or partly exteriorly; animal with the foot small and compressed; the tubes are united and short. *Mactra Neapolitana*, pl. 24, f. 40. *b c*, the trachæa; *d*, the foot.

SECTION IV.—CRASSIPEDES.

The mantle, either entirely or in part united before the foot, thick, placed posteriorly; the shell gaping when shut.

FAMILY I.—MYARIA.

Shell with a broad spoon-shaped tooth in each valve, or in one only, and gaping at both lateral extremities, or at one only; ligament placed interiorly. Live sunk in ooze or sand. *Mya arenaria*, pl. 24, f. 45.

FAMILY II.—SOLENIDES.

Shell transversely elongated, without accessory pieces, and gaping at the lateral extremities only; ligament placed exteriorly; the foot issues from the anterior extremity or from that side in which the teeth are nearest. *Solen Vagina*, pl. 24, f. 96. The foot of the animal is conical, which enables it to burrow with great facility in the sand. *e*, the trachiæ; *k*, the cloak; *n n*, the adductor muscles; the foot, *b c*.

FAMILY III.—PHOLADARIA.

Shell bivalve, with accessory pieces to the valves; they generally gape much anteriorly. The whole family are borers. *Pholas dactylus*, pl. 24, f. 95. f. 89, muscle of do.

FAMILY IV.—TUBICOLA.

Shell contained in a testaceous sheath, distinct from its valves, incrusted entirely or in part in the wall of this tube, or projecting outwards. *Teredo navalis*, pl. 24, f. 16. These acephala, while quite young, penetrate and establish their habitations in submerged pieces of wood, such as piles and the bottoms of ships; completely destroying them in a very short space of time. *a*, the œsophagus, which is very short, and lies on the left side of the neck; the canal swells out, and becomes a stomach, *b*, which, in its external appearance, is a large bag, extending the whole length of the cavity of the abdomen, but, when laid open, it is found to have a septum, *c*, dividing it longitudinally into two equal cavities, except at the lowest part, where they communicate at *d*, the septum being wanting. The intestine has its origin close to the termination of the œsophagus, is extremely small, dilates into a cavity containing a hard, white spherical body, the size of a pin's head, and then makes a turn upon itself. The course it follows is shown by the letters *e e*.

CLASS CIRRIPEDA.

The Cirripeda form an intermediate group between the Mollusca and Articulata. The bodies are enveloped in a mantle, and testaceous plates or valves, which are nearly allied to those of the Acephala. The mouths of the animals are provided with lateral jaws, and the abdomen with filamentary jointed processes, named *cirri*, arranged in pairs, composed of numerous little ciliated articulations, and corresponding to feet or fins, similar to those which exist under the tail of crustaceous animals. Their heart is situated in the back, and the branchiæ emanate from the sides; the nervous system forms a series of ganglions, on the lower part of the abdomen. These cirri, however, may be considered as analogous to the articulated appendages of some species of Terredo, while the ganglions are in some measure repetitions of the posterior ganglion of the bivalve Mollusca. The position of these animals in the shell is such, that the mouth is at the bottom, and the cirri near the orifice. Between the last two cirri is a long fleshy tube, that has sometimes, but erroneously, been taken for their proboscis, and at the base of which, near the back, is the anal opening. Internally, a stomach is found inflated by a multitude of small cavities in its parietes, which appear to fulfil the functions of a liver, a simple intestine, a double ovary, and a double serpentine oviduct, whose walls produce the prolific fluid, and which, prolonged in the fleshy tube, open at its extremity. The animals of this class are incapable of locomotion, being always fixed. This class was all ranked under a single genus by Linnæus, by the title of Lepas. Brugieres divided them into two, and Lamarck has subdivided them still further, at the suggestion of Dr Leach, and they now form a class of themselves. The animals of this class are always protected by a multivalve shelly covering, which is composed of a number of separate pieces; these are connected by a membrane in the *pedunculata*, and those of the *sessilia*—six in number—are articulated at their sides, and kept together from their base, being attached to a calcareous plate, which is firmly attached to some extraneous substance. These last form a conical covering, open at the top, which is protected by an operculum or lid, composed of four pieces. The first order of cirripeda have but five valves, and these are placed on the summit of a tubular, membraneous peduncle, varying in length in different species. In one genus, besides the five principal valves, other smaller ones are found, which are termed accessory valves. All the animals are hermaphrodite and marine. The characters of the class are, soft animals, destitute of head and eyes, covered with a plurality of shells, and always fixed to a certain spot; the bodies are inarticulated, provided with a mantle, tentacula, and cirri; arms issuing from above, and many-jointed.

ORDER I.—PEDUNCULATA.

The body compressed, and supported on a tubular peduncle. *Otion Cuvieri*, pl. 33, f. 26. *Cineras vittata*, pl. 33, f. 27. *Pollicipes mitella*, pl. 33, f. 28. *Anatifa vitrea*, pl. 33, f. 30.

ORDER II.—SESSILIA.

Body destitute of a peduncle, and inclosed in a shell of various parts, fixed immovably by its base, with a testaceous lamina to extraneous marine bodies; the mouth at the upper and anterior part of the body. In the interior of the opening is placed an operculum formed of two or four movable pieces, which the animal opens in the centre while projecting its tentacular arms. *Pyrgoma crenata*, pl. 33, f. 31. *Balanus communis*, pl. 24, f. 94. *aa*, the ventre; *vv*, the liver; *xx*, the ovarium; *h*, the spermatic ducts; AB, the œsophagus.

CLASS ANNELIDES.

This class is the first of the great division Articulata, consisting of animals which have their bodies or members composed of articulated rings. The characters of the Annelides, are, the body soft, more or less elongated, and either naked or enclosed in a tube, and divided into a number of segments ; and are the only animals devoid of a backbone, which have red blood circulating in a double system of complicated vessels. Their nervous system consists in a double knotted cord, like that of insects. Some species have a head, and others are devoid of one ; when it exists it is merely a slight anterior thickening, distinct from the first segment of the body, and upon which the eyes and antennæ are placed. The antennæ consist of articulated filaments, sometimes short and thick, and never exceed five. They have either two or four eyes, situate behind the antennæ. The tentacula are either situated on the head or fore part of the body, they consist of articulated filaments, or papillæ more or less elongated. They are provided with a fleshy contractile proboscis, of either one or two rings, inclosing horny or calcareous jaws. The body of the Annelides in many species is naked, and free from hairs ; some are furnished with contractile bristles. The whole class respire by branchiæ, and inhabit the waters, sand, mud, or moist earth. The branchiæ are extremely variable in form and situation ; as are also the tubes or sheaths, which are either membranous or horny, incrusted exteriorly with minute fragments of shells or grains of sand ; in others they are solid testaceous tubes. They are all carnivorous, sucking the blood of other animals ; and are hermaphrodite.

ORDER I.—SEDENTARIÆ.

The animals inhabit a testaceous tube, which they never leave; they are destitute of eyes; the branchiæ are situated at one end of the body. The animal is elongated, worm-shaped, having the sides of the body provided with subulate short bristles; and also with hooked bristles to enable it to move in its tube.

Family I.—Serpulacea.

Branchiæ separate, or covered by an operculum; tube, solid and testaceous; destitute of tentacula, eyes, or jaws; body furnished on the sides with setaceous papillæ, and hooked retractile bristles. *Serpula vermicularis*, pl. 24, f. 82.

Family II.—Amphitritæa.

Branchiæ neither separated nor covered by an operculum, and disposed towards the anterior part of the body; with a horny or membranous tube, more or less arenaceous; the branchiæ are placed at or near the anterior extremity, they are sometimes large, projecting above the mouth, and sometimes they are short. Many of the animals have tentacula, but all of them are destitute of eyes, proboscis, or jaws. *Amphitrite magnifica*, pl. 24, f. 81.

Family III.—Maldaniæ.

The branchiæ are indeterminate; and the tube is open at both ends. *Dentalium entalis*,

Family IV.—Dorsaliæ.

The branchiæ are dorsal, or disposed longitudinally along the body. *Siliquaria anguina*, pl. 33, f. 51.

ORDER II.—ANTENNATÆ.

The head is antenniform, provided with two eyes, and a projectile proboscis, frequently armed with jaws, and setiferous retractile pediform papillæ; branchiæ disposed longitudinally.

SECTION I.

Branchiæ in the form of complicated leaves or tufts, or very ramose, always large and apparent; destitute of spines.

Family I.—Amphinomæ.

Branchiæ and cirri placed superiorly at all the pairs of pediform papillæ, and having no jaws.

SECTION II.

Branchiæ in the form of small crests or laminæ, or filamentous and pectinated on one side; sometimes not distinct.

Family II.—Eunicæ.

While the branchiæ are distinct, all the pediform papillæ are placed without interruption; jaws numerous, and always more than two, but fewer on the right than on the left side; destitute of the first pair of feet.

Family III.—Nereides.

When the branchiæ are distinct, there are superior cirri on all the pairs of pediform papillæ; two jaws or none. *Spio quadricornis*, pl. 27, f. 14.

Family IV.—Aphroditæ.

The upper branchiæ and cirri alternating in their position to the twenty-third or twenty-fifth pair of pediform papillæ; having four jaws. *Halithea aculeata*, pl. 27 f. 4.

ORDER III.—APODES.

Animals destitute of feet, or setiferous and retractile papillæ; when provided with branchiæ, they are disposed interiorly along the body; but they have no antenniferous head. Although the animals of this order have red blood, and a true circulation, they are otherwise the most imperfect in their form. They are destitute of head, tentacula, and pediform papillæ; their branchiæ are situated internally, either in or under the skin. They are usually naked, and have no retractile spines.

Family I.—Echioreæ.

Body with bristles projecting, but not retractile. *Lumbricus terrestris*, pl. 27, f. 39. The earth worm.

Family II.—Hirudineæ.

Body without projecting bristles. *Hirudo geometra*, pl. 27, f. 13. Leech. See it described in the present volume, at p. 467.

SUPPLEMENT

ON

MICROSCOPIC DISCOVERY.

INTRODUCTION.

The invention of the microscope is justly considered one of the most important achievements of human science and art, claiming at least equal eminence with the discovery of the telescope. The latter instrument brings us into comparative intimacy with other worlds, or what we infer to be such from the analogies discoverable between them and our terrestrial globe; the former instrument carries us to the opposite bounds of creation, and reveals the atomic miracles with which we are immediately surrounded. The results of astronomical research usually strike us with more awe than those of microscopical inquiry; yet perhaps we regard the latter with deepest interest, and for this reason,—the telescope communicates a few particulars concerning things on which we can bring but *few* analogies to bear, and consequently imparts a vague and indefinite knowledge to the mind; the microscope, on the contrary, refers us to objects wonderfully minute, yet usually so analogous to larger existences, that the information derived concerning them is satisfactory and complete.

To estimate duly the value of the microscope, as a means of enlarging the boundaries of human knowledge, we must refer to the utter ignorance concerning some things, and the gross misconceptions regarding others, that prevailed prior to its introduction. Before the invention of this instrument, the mite was considered the least of animal beings, and the existence of living atoms, with which compared, the mite may rank as an elephant, had never been conjectured. The wondrous beauty and contrivance in the formations and appendages of the insect tribes had never been beheld. The miracles of creative power, folded up in every plant and blossom, had not been fully displayed. Vague and indefinite opinions were held regarding the vital fluid in animals; and the manner of its circulation through the body was very imperfectly understood. The strange fallacy of equivocal generation was universally maintained, and fetid corruption was deemed the parent of animal and vegetable life. It would occupy much space to name all the instances of ignorance and misconception that characterized the times in which the microscope was unknown: let those to which we have alluded suffice to show how limited was the sphere of human knowledge concerning many things that daily met the eye, and how totally unconscious were the philosophers of those ages of the wonderful creations that science and art were preparing to unveil. "Who," says Baker, "would have imagined it possible to distinguish myriads of living creatures in a single drop of water! Or, that the purple tide of life, and even the globules of the blood, should be seen distinctly rolling through veins and arteries smaller than the finest hair? That millions of millions of animalcules should be discovered in the *semen masculinum* of all creatures? That not only the exterior form, but even the internal structure of the bowels, and the motion of the fluids in a gnat or louse should be rendered objects of sight? Or, that numberless species of creatures should be made visible, though so minute, that a million of them are less than a grain of sand? These," he continues, "are noble discoveries, whereon a new philosophy has been raised, that enlarges the capacity of the human soul, and furnishes a more just and sublime idea than mankind had before, of the grandeur and magnificence of nature, and the

infinite power, wisdom, and goodness of nature's Almighty Parent."[1]

At the period when Goldsmith wrote, the microscope had certainly been long in use, and allusion is made in his Natural History to some of the interesting facts it had then made known. When, however, we consider the inefficient construction of the instrument, the consequent unsatisfactory results of many observations, and the prevailing tendency to exaggerate the discoveries of that day, we are at no loss to comprehend the reason why our author lays comparatively little stress on microscopic inquiry. Subsequent editions of the Natural History have, it is true, supplied in a good measure this deficiency in the original work, and presented to the popular view a large amount of discoveries in the minute world; this information, however, has usually been conveyed in a desultory form, ill calculated to impress upon the mind the vast accessions of knowledge progressively derived from microscopic investigation. The attention which has, in late years, been given to the construction of the microscope and the improvement of its elements, has given a new impulse to inquiry, and led to the elucidation of facts so astonishing, and to the discovery of formations and phenomena so replete with interest to the natural historian, that a new edition of Goldsmith's work could scarcely be deemed complete if it did not include a connected view of the most remarkable discoveries that have been made in the various kingdoms of nature by the aid of optical science. This digest we propose to give in three consecutive chapters, dividing the subject as follows:—

Chap. I. The results of microscopical inquiry concerning the minute formations and phenomena of the natural world.

Chap. II. Infusorial Animalcules.

Chap. III. Spermatic Animalcules.

CHAP. I.

THE RESULTS OF MICROSCOPICAL INQUIRY CONCERNING THE MINUTE FORMATIONS AND PHENOMENA OF THE NATURAL WORLD.

Microscopic investigation has been carried to a greater or less extent through all the kingdoms of nature. We shall, for the sake of orderly arrangement, commence with the *Mineral Kingdom*, the discoveries in which, though less diversified, are equally interesting with those in the animal and vegetable worlds. In this division of the subject our attention is more particularly called to the remarkable phenomena connected with congelation and crystallization, to the formation of minute mineral bodies, and to fossil remains of insects, animalcules, and vegetables. We shall first advert to the singular appearances presented in the congelation of water and snow crystals; for though these cannot be included amongst mineral bodies, they can be more conveniently reviewed in this place than in any other department of our essay.

If water be exposed to a freezing atmosphere in a capacious vessel, thin laminæ, or plates, of ice will shortly be observed on its surface. These cross and intersect each other in a most surprising manner, and present the appearance of a fancifully tesselated device. If one of these plates be separated from the rest with a knife and brought under the microscope, a moderate power will develope its conformation, which much resembles that of a herring bone: a large stem runs through the centre, and from each side of this diverge a number of parallel spines, inclined to the central stem in an angle of about sixty degrees. In the Micrographia of Dr Hooke notice is taken of a peculiarity in the congelation of water thinly spread on smooth marble, which is said to exhibit a variety of figures resembling feathers; these forms are however nearly allied to the plates before mentioned, and the points of difference between them are not particularly remarkable. Urine when slightly frozen discovers a number of very beautiful six-branched figures; but as the same formations, or others very closely resembling them, may be observed in a congelation of common salt and water, we prefer directing our remarks to the latter. These star-like figures commence at the centre, which elevates itself, and ultimately forms the apex of a solid angle; from the centre six branches jut out, each two inclosing an angle of sixty degrees; from these main branches proceed a number of smaller shoots, all on the same side of the branch being parallel to each other, and forming with it an angle of sixty degrees; from these shoots issue forth smaller branchings in like manner, and from these latter others still more minute, till at length the figure becomes too complicate to be analysed, and presents merely the appearance of an even mass of ice. It is however to be observed, that the beauty of these stars is greatly enhanced by accidental circumstances, which disturb the regular process of congelation, and cause the branches at times to throw out a number of circular plates curiously overlapping each other. It may be necessary to add that these figures differ materially from those observed in the ordinary crystallization of common salt by evaporation.

[1] See article *Microscope*, in the Supplement to *the Popular Encyclopedia*.

The fantastic and picturesque formations so commonly observed on the windows in the winter season, will, if closely examined, be found to consist of a series of branches disposed under the uniform angle of sixty degrees; and all the irregular variety is merely the result of numerous small impediments to the freezing process.

An almost infinite variety of configuration may be observed in the flakes of falling snow, all however thus far resembling each other, that they uniformly consist of six branches radiating from a centre. The side shoots are also disposed according to the general principle, and in all the peculiarities of figure we discover the angle of sixty degrees determining the formation. Plate 35, figs. 50 and 51, are two snow flakes. In fig. 50 we observe the branchings from the centre, and the side shoots disposed according to the general law. The hexagonal figures terminating the main branches are explained thus: the two sides connecting with the branch are lateral shoots from it, the two next are lateral shoots from the former two, and the other two sides are similar shoots from the second two. And it is in this manner by a little consideration of the figure, that we are enabled, in almost every instance, to trace out a uniform principle of conformation. In fig. 51 we see the six branches and the lateral shoots as before, and the leaf-like outline of the figure is nothing more than the natural result of the lateral shoots near to the centre pressing upon each other, and the central ones extending farther out than those more recently put forth.

Congelation and crystallization, though closely resembling each other, are distinct operations. Congelation fixes the whole fluid mass; but the process of crystallization causes the particles of mineral bodies, when suspended in fluid or separated by fusion, to assemble in regular figures, agreeably to ascertained principles of formation.

Notwithstanding the variety of figure observable in crystals, their primitive forms are few, such as the cube, parallelopipedon, &c.; and all eccentric formations arise from a peculiar arrangement of their laminæ on the faces of the primitive crystal. Dr Hooke suggested that crystallization merely exhibited the various regular forms resulting from the combination of small globular particles; and this opinion has been adopted by many writers. There is, however, a difficulty in conceiving how globular particles should with undeviating exactness constantly assume the same primitive figure, in (for instance) the crystallization of common salt. The simple form of these crystals is always a cube; now we cannot comprehend the reason why this should be the case on the supposition that they are merely an accumulation of globular particles; for these particles can unite only by mutual attraction, and might, for ought we perceive to the contrary, assemble in any other primitive form as readily as that of the cube. A more recent theory supposes the particles to have either the figure of the primitive crystal or that of a cube, a solid angle, or a parallelopipedon; and we can pretty well discover in every instance, on this hypothesis, how the primitive form is invariably determined. Much light has been thrown upon this subject by the microscope, which brings immediately under the eye of the observer the whole process of crystallization, from (in several cases) the primitive form, to the most intricate combination which it ultimately develops. A more beautiful sight cannot be conceived than that which is presented when any saline solution is suffering gradual evaporation under the microscope, and the crystals begin to shoot and extend themselves over the field of the instrument. It is not exaggeration to say that it partially draws aside the veil that is cast over the first creation of material forms. Adopting the hypothesis, that primitive chaos was a fluid holding in solution the particles of all solid matter, we may imagine the small drop of water on the stage of the microscope to be that chaos, from which we see glaciers and rocks rising up with a rapidity, precision, and beauty truly astonishing.

In Plate 35 the figs. 44 and 45 exhibit the compound crystals of common salt. These have been selected for illustration in consequence of their showing the process of superposition in the most simple manner. The figures closely resemble each other; but in fig. 44 the various laminæ are not so easily recognized as in fig. 45. The crystal commences with the formation of the nucleus, which in this case is a very minute cube, composed of cubic particles; a layer of four similar cubes immediately begin to form under this nucleus, and raise it up, or propel it forward; a third layer of nine similar cubes then form under the layer of four; and thus the crystal goes on increasing, each successive layer taking an additional cube into the side. Now as the cubic *particles* are small beyond our comprehension, and since the aggregation will frequently be affected by the superposition of laminæ, the thickness of these particles only, it is easy to conceive the reason why, even in microscopic crystals, the sides frequently present to our weak vision, and its limited aids, a perfectly polished surface free from all irregularities. In fig. 44, the laminæ are not perceptible towards the apex of the crystal; whilst in fig. 45 the layers are distinctly recognised: these varieties are the result of mere accidental circumstances, in the

one case facilitating, and in the other retarding the formation of the successive layers. Fig. 48 is an irregular formation, in which, however, the different laminæ exhibit themselves with much distinctness. Figs. 47 and 52 are likewise crystalline structures of common salt; but their integral parts are too minute to be particularly noted; they are drawn exactly as they appear under a superficial magnifying power of 90,000. Fig. 46 shows the crystals of saliva, under the same amplifying power; these, as might naturally be expected, bear strong resemblance to, indeed are nearly identical with, fig. 52.

Our limits will not permit us to enter extensively into the subject of crystallization; but we deem it sufficient to have called attention to the fact that the microscope is an invaluable assistant in detecting the process by which crystalline structures are matured. For the instruction of young experimentalists, we may add, that the salts whose crystals they wish to examine must be dissolved in water; metallic substances, and those which have metallic bases, on being heated, give out crystals as they gradually cool; these latter exhibit beautiful conformations when immersed in solutions that act upon them chemically. We conclude with an extract, relevant to our subject, from Gould's *Companion to the Microscope*, a useful little treatise, by a talented and practical man:

"Another important field of inquiry by the microscope is chemical action. This opens an endless subject of investigation of a very rich order. The mode of pursuing this class of observations is very simple. Prepare a few pieces of thin and perfectly flat glass, of a size suitable to the stage of the microscope; some of these should be the eighth of an inch less every way than the others. A variety of chemical agents should be provided in small glass bottles with stoppers, and a few glass rods about four inches long, with a rounded end, for the purpose of taking up a small drop of liquid. In experimenting, at the outset adapt the focus of the microscope to one of the glass plates. Then, upon one of the larger plates, spread thinly any chemical substance with which you wish to work. Lay the glass upon the stage, and examine leisurely the character and form of the substance. Then, upon one of the smaller glasses, lay, with a glass rod, a small drop of any acid or other fluid with which you wish to act; and, having spread it on the glass, lower it down nearly upon the other glass, so that the edges of the upper glass shall not reach beyond the under one; as the upper glass, when once brought in contact, should never be disturbed. The two substances will thus, by pressure, be reduced to one uniformly thin film; and the action which takes place may be very accurately investigated.

"For instance, let the first glass receive a very minute portion of the carbonate of copper, and the upper glass a drop of nitric acid; on contact, the carbonic acid of the carbonate will be seen coming away in globules, whilst the carbonate of copper breaks down and disappears. The field is gradually occupied with a solution of nitrate of copper; and this is seen to crystallize in minute rhombic crystals. Lift up the upper glass, and add a small drop of ammonia, and slip down the glass again; the crystals of the nitrate disappear; a new combination takes place; and you see the beautiful foliations of the nitrate of ammonia interspersed with groups of the still more beautiful prisms of the deep blue ammoniuret of copper. Or, instead of the ammonia, add muriatic acid; the nitrate is changed into a grass-green solution of the muriate of copper, which crystallizes in bundles of spears shooting in all directions across the field of vision.

"These phenomena may be multiplied to any extent by the use of the numerous chemical agents to be obtained. Iodine presents an endless variety of aspects in combination with different agents. The crystallization of hydriodate of potass is very beautiful, if a drop of the solution is put on a glass. Put on the other glass sulphuric acid. When brought in contact, the acid takes the potass, and forms crystals of the sulphate of potass, and the iodine is developed both in solution, which passes off by evaporation, and in the crystalline structure of the substance itself. Again: combine solution of iodine with solution of sulphate of soda. The alcohol, in the solution of iodine, takes part of the water from the soda, and the rest of the sulphate of soda crystallizes in prisms. The iodine, deprived of the alcohol, is developed in cherry-red drops of liquid and in dark rhombic crystals.

"To these observations may be added, the examination of various crystallizations in polarized light. Between the reflecting mirror and the stage of the microscope insert a plate of tourmaline, so that the condensed light of the mirror be thrown upon the object through the tourmaline. This polarizes the light received. Then above the eye-piece lay another plate of tourmaline, or, what is better, an analysing prism of Iceland spar. This enables the observer to perceive the changes produced by the polarized light. Many crystals so observed, as sulphate of potass, &c. exhibit the most beautiful colouring, according as the upper plate of tourmaline is turned round on its axis. Some crystals, as nitrate of potass, exhibit these colours without the upper, or analysing plate. The laminæ of the crystal itself, as is the case with the mineral called iolite or

dichroite, serve to polarize the light passing through it, and to make it visible.

"A few other similar experiments may be mentioned:

"1. Add sulphuric acid to common salt, or muriate of soda, or to carbonate of ammonia.

"2. Add sulphuric acid to bichromate of potass or muriate of soda. The result is crystals of sulphate of soda, with chloro-chromic acid.

"3. Add acetic acid to the bichromate of potass. The crystallization of the bichromate takes place in very beautiful forms.

"4. Add sulphate of alumina and potass to muriate of cobalt. The crystals of the alum form in great perfection.

"5. Add acetic acid to nitrate of copper. The biperacetate of copper forms slowly and crystallizes in great beauty.

"6. Add terrocyanate of potass to sulphate of iron.

"7. Add nitrate of potass, or aqua potassæ, to sulphuric acid. The sulphate of potass forms in solution. Raise the upper glass with a knife the smallest degree, and let it fall again; the crystallization is instant.

"8. The smallest drop of any liquid containing lead may be examined by the usual tests for lead; and wine may, in the same way, be tested in a drop not bigger than a pin's point.

"9. The ben-iodide of mercury is a beautiful crystal, and open to a variety of experiments.

"10. Investigate the comparative purity of successive crystallizations of nitrate of potass."[1]

In proceeding to consider the formation of minute mineral bodies, our attention is called, in the first place, to what are designated the *active molecules* of matter. With the exception of bodies perfectly soluble in water, metals that cannot be reduced to atoms sufficiently minute, and a few other substances, the whole range of matter exhibits the phenomena of molecular activity. The method of bringing these atoms under microscopic investigation is very simple. On a slip of glass, adapted to the stage of the microscope, place a small drop of water; then with any substance sufficiently hard, rub the mineral body whose atoms you require; touch the water with the rubber, and it will transfer to the fluid the minute particles separated by friction. Apply a deep power, say a one-twentieth inch doublet, and a vast number of apparently small spheres will be seen in rapid and continual motion. This motion of the particles will not cease in any definite time, if care be taken to supply fresh water as the other evaporates. The movement of these atoms very closely resembles that of the infusorial monads and the spermatic animalcules. The writer was led himself to experiment on the nature of these active molecules, and from a variety of phenomena presented by minute particles of camphor floating in spirits of turpentine, he was led to attribute the activity to electric or magnetic agency. Having put a drop of spirits of turpentine on a slip of glass, he added thereto an extremely thin shaving of camphor, which was rapidly decomposed by the spirit, and fell down into minute crystals, spheres, cylinders, circular planes, &c. The activity of these tiny forms was truly wonderful and delightful to witness; and though this is not the great point to which he would now direct attention, he still thinks that a detailed account of the appearances will be interesting to all who have not made similar observations. The crystals were rhomboidal, and frequently revolved with greater or less rapidity on their longest axis; after turning one way for some time, they would then reverse their motion; at other times, the revolving movement would be entirely suspended, and they would direct alternately the two ends (poles?) of their axis to some particular point in the field. The spheres exhibited the same phenomena in revolving, with this peculiarity, that the rapidity of their motion far exceeded that of the crystals; and whenever they ceased to revolve, it was to fly off in a right line to another quarter of the field. It should be remarked that whilst revolving, neither the crystals nor the spheres made any progressive advance, at least speaking generally. The circular planes revolved in like manner on a diametric axis; and these progressed over the field in the direction of the revolution. The small cylindric forms pointed their ends alternately to the same point, frequently revolved on their axes, and occasionally exhibited all the lively motions of the most active vibrio animalcules. When the crystallizing process began, as the turpentine evaporated round the edges of the field, these several forms cleared from the centre and united themselves to the foliations. It was then that a vast number of very minute particles were discovered, moving rapidly in the manner of ordinary molecular atoms; as the star-shaped crystals began to form in the midst of them, they were seen to strike rapidly and repeatedly against the projecting points, till at length they adhered to the mass, and were incorporated with it. The phenomenon was precisely that of an insulated cork ball striking against the conductor of an electrical machine, in which case it becomes electrified itself and is repelled, when quickly losing the electricity it had acquired, it again strikes the conductor. It seems probable then that molecular activity is the mere result of successive attraction and repulsion among a vast number of suspended particles; and it does not appear difficult to conceive that motion will be-

[1] Gould's Companion to the Microscope, p. 62, et seq.

get motion in such a host of atoms, and that their activity may be indefinitely prolonged. We shall again refer to the activity of molecules when we come to speak of infusorial and spermatic animalcules whose movements they greatly resemble.

Ores and minerals should first be examined in very small portions in their native state; as their complex structure cannot be so well understood from an artificial crystallization, which rather developes primitive forms and elementary principles. The crystalline formations and foliations of any mineral may be subjected to microscopic examination, by dissolving a few particles in muriatic or nitric acid. It would answer no purpose to enter into an extended description of the crystalline structures of minerals, as exhibited under the microscope; since these can only be adequately comprehended from actual observation, or from very elaborate illustrative engravings. We shall therefore confine ourselves to the mention of a variety of minute native bodies discovered by various observers.

On the sea-shore, along the banks of rivers, and in many inland places, various species of sand are discovered, widely differing from each other, and all exhibiting a beauty of structure and finish well worthy of observation. "These species differ in colour, figure and size; and as among stones some are called precious for their excellency, so also amongst sands there are some that deserve the same epithet for their beauty. The grains of sea-sand are very large, and afford great variety of all shapes and colours, both opaque and transparent. River sands are smaller grained, of different colours and forms; and the inland, or pit sands, vary also exceedingly, being some white, some brown, some yellow, &c." "These varieties are very agreeable to examine by the microscope, which shows, in some of the shining kinds, grains having all numbers of sides and angles, and so finely polished, that no diamond is more exquisitely beautiful. On others, grotesque figures, or representations of landscapes, buildings, plants and animals at once surprise and please." There are several kinds of black sand brought from the East Indies, and also from Virginia and other parts of America, which exhibit beautifully polished surfaces, and may be attracted by the load-stone. A red-coloured sand is also brought from abroad (we believe from Africa) which presents a delightful picture under the magnifier, resembling a heap of gems carelessly thrown together.

Small, irregularly shaped particles of the precious stones, are very interesting microscopic objects. Leuwenhoeck's method of examining the diamond, and the phenomena it presented, are thus described by Baker. "He broke a small one between two hammers, and placing the pieces before his microscope, in the sun-shine, he saw many sparkling flames issue from them, with a continual corruscation, in some, like faint lightning. Then viewing them in the shade, he observed, among other pleasing appearances, a little flame that seemed to dart from each particle of the diamond: and it was a glorious sight to behold multitudes of sparkling flames, most of a bright fire colour, and others greenish, flashing faintly and like lightning at a distance. In other pieces of the diamond the *lamellæ*, or layers, were very plainly distinguished." This description is somewhat grandiloquent, yet perfectly agrees with later observations: the powerful refractions of this gem and its structure are both very distinctly developed by the microscope. Minute crystalline formations, vulgarly called diamonds, are frequently found in the cavities of flint or rock; these vary considerably in form, and by their action on the rays of light become objects of great interest to the microscopical observer. Sir David Brewster has called attention to the singularly shaped microscopic cavities in gems and other mineral bodies, "containing two fluids unknown to the chemist, groups of crystals, floating balls, and exhibiting actual chemical operations going on in these minute laboratories when exposed to changes of temperature. In some of the precious stones, particularly in diamond, garnet, &c., these cavities are perfect spheres." In his recent Treatise on the microscope, this unwearied observer gives diagrams of "the cavities containing the two new fluids that will not mix, though in the same cavity;" and also of the beautiful spear-shaped cavities formed in topaz.

The examination of the inferior minerals, such as common free-stone, &c., whilst it has gratified the observer with a view of their structure, has also developed serviceable truths relative to the value and capabilities of the materials in the ordinary concerns of life. Their compactness or porosity, their durable or perishable nature, may be determined with much exactness by the aid of the microscope. What is called Kettering stone (from the locality of the quarry whence it is dug) is shown, for example, to be eminently adapted for filters, as it is composed of small globular particles cohering so firmly together as to form a substance harder then free-stone, yet is filled with innumerable interstices arising from the spherical surfaces touching only in certain points.

Before dismissing this portion of our subject, it may be interesting to transcribe the remarks of the old micrographers regarding the minute globules of steel produced by the com-

mon operation of striking fire from flint and steel.

"In the common way of striking fire with a flint and steel, fiery sparks fly out at every blow; which sparks are nothing more than small pieces of the flint or steel, (but usually of the steel) broken off by the violence of the stroke, and either melted instantaneously into steel globules, or made at least red hot, and thereby capable of kindling tinder or touchwood. The heat is likewise so intense as sometimes even to vitrify the broken particles. Dr Hooke struck fire over a sheet of very white paper, and observing diligently where the sparks seemed to vanish, he discovered there certain very small, black, but glittering and movable specks, which when examined with his microscope, appeared to be little round globules; some whereof did, from their surface, yield a very bright and strong reflection on that side next the light, and resembled iron balls. The melting of the particles of steel, instantaneously, upon the collision, is very wonderful, and comes up nearly to the effects of lightning." The combustible nature of iron and steel is evidenced by the simple experiment of letting drop the filings of either through the flame of a candle, when a number of the particles will be found melted into small globules. On burning a red wafer over a piece of glass, and submitting the latter to the microscope, several very regularly formed globules of lead will be discovered.

We must now glance at the minute petrifactions, and fossil remains, of marine animals, insects, animalcules and vegetables; and this division of our subject will bring before us startling discoveries, to which the mind is scarcely disposed to give credence. A little reflection, however, upon the mighty operations which are continually going forward in the microscopic world, will lead us to apprehend so much of these wonders as is necessary to excite our belief in them. We shall of course be understood to refer to the infusorial organic remains discovered by Ehrenberg.

Referring to the remains of marine animals, Mr Pritchard has the following observations, in his *Microscopic Illustrations*, p. 20 :—"Look at the discoveries of Agassiz on the fossil creatures of the deep! By a microscopic investigation of such portions of them as have withstood the destructive power of time, namely, their scaly covering, he has been able so to group and class them, that the characters and habits of the genera belonging to each distinct era are clearly demonstrated. A microscopic examination also of the testaceous remains of sundry Entomostraceans, found in slate-clay formations, now elevated much above the level of the sea, prove them to have been at some time or other imbedded in the waters. And the naturalist may even determine by an inspection of the shell, whether the species were the inhabitants of fresh or salt water, and consequently whether the strata themselves were the indurated beds of the sea, or of some river or lake."

Fossil remains of insects have hitherto rarely been met with; and of those which have been discovered very few are satisfactorily developed by the microscope. Blumenbach divides them into three sections.

I. "The *Determinable;* such for instance as those found in the schist at Oeningen, larvæ of Libellulæ, Notonectæ, &c. II. *Dubious;* to which head belong most of those inclosed in amber, as also most of the petrified crabs. III. *Unknown;* such are the celebrated Dudley-fossils, which are found in various places, but no where finer than at Dudley, in Worcestershire, and frequently retaining their crab-like shell." Plate 4, figs. 39, 40, 41, 42, 43, 50, 95, represent a few of the insects that have been discovered in a fossil state; as these are particularly noticed in the general summary of organic remains, it would be needless repetition to describe them here. Plate 35, fig. 41, exhibits a singular insect, much resembling a mite, discovered in a siliceous formation at Uckfield in Sussex. It is drawn with nearly four times the surface it exhibited under a doublet of one-thirtieth inch focus. Its real size seems to vary from 1-3000th to 1-1500th of an inch in diameter.

The recent discovery of animalcular fossils by Dr Ehrenberg of Berlin, has caused a great sensation in the philosophical world, and promises to aid in no small degree the advancement of geological science. "These remains," says Sir David Brewster, "are the siliceous shells of animalcules belonging to the division *Bacillaria*, and form strata of tripoli, or poli-schiefer (polishing-slate), at Franzenbad, in Bohemia. M. Ehrenberg has still more recently discovered them in the semi-opal found along with the polishing-slate in the tertiary strata of Belin, in the chalk flints, and even in the semi-opal or noble opal, of the porphyritic rocks. The size of a single individual of these animals is about 1-288th of a line, or 1-3456th of an inch. In the polishing slate from Belin, in which there appear to be no vacuities, *a cubic line* contains, in round numbers, 23 millions of these animals, and *a cubic inch* contains 41,000 millions of them. The weight of a cubic inch of the polishing-slate is 270 grains. There are, therefore, 187 millions of these animals in a single grain, or the siliceous covering of one of these animals weighs the 187th millionth part of a grain!"

We anticipate the questions which will arise on a perusal of this brief statement:—

How can animalcules so inconceivably minute be congregated in such masses? What new powers have been added to the microscope by which it is enabled to develope these delicate formations? In reply to the latter question, we simply state the fact, that recently a high degree of defining and penetrating power has been given to the microscope, for want of which, at an earlier period, researches into the minutiæ of nature were frequently inconclusive and deceptive. Deeper magnifiers than any formerly known are now, also, brought into effective use. The first inquiry,—how can these animalcules be collected in such countless myriads of myriads?—will be satisfactorily answered in the following extracts from a most talented article in Chambers' Edinburgh Journal.

"The productions of the kindred zoophytes, in the innumerable coral reefs and islands which bestud the ocean, are truly wonderful; but not less astonishing certainly is it, that the organic remains of these invisible atoms should abound to such an extent, as actually, in the language of Dr Ehrenberg, to swell in no small measure the amount of the solid matter of the crust of the globe. Many of these animalcules are of a beautiful green colour. If water, then, containing some of these, be taken from a pool or marsh, and conveyed into a covered vessel, a layer of fine powder, speedily becoming a green crust, will ere long be found on its surface, and more particularly near the margin of the glass. This crust, at first a bright green, gradually assumes a brown and yellow hue. This constitutes the well known *Priestley matter* of former days, which at one time so much engaged the attention of philosophers. It seems formed of the more solid portions of these animalcules, which, in successive generations, have ceased to live." The fecundity of these small animals is beyond all conception: each individual produces a host; and "generation succeeds to generation with a rapidity which cannot be estimated, and their remains thus accumulate in countless myriads, and to a vast extent." The slimy substance which not unfrequently covers stagnant waters, and is sometimes spread over wet and marshy soils, has been discovered to consist of large masses of animalcules in thin layers. "When we are thus informed of layers of dead infusoria formed on common marshes, or in ditches, we are in some measure prepared to understand how the same substances may have formed great layers or *strata*, taking their place amongst the other rocks which fall under the attention of the geologist. The fact, however it may be received, is so. Vast layers of rock, at or near the surface of the earth, and many feet in thickness, have been discovered in various parts of the world, which the microscope has found to be composed solely of the shields or hard parts of Infusoria; these remains of Infusoria having, of course, been deposited from great bodies of water which formerly overspread the place. Dr Ehrenberg has actually shown, by experiment in the royal deer park at Berlin, how such rocks may be formed by means of the Infusory tribes; and the only difference between the crust formed in experiments like his, and a layer of rock several feet thick, and of large extent, is in the scale on which the phenomenon takes place. In the one case we have a natural operation on a large scale, and in the other an artificial operation on a small one. All the other features of the process must be considered as identical." The writer from whom we have been quoting, dismisses his subject with these apposite remarks:—"No doubt the abundant vegetation of the elder world, to which we are also indebted for our beds of coal, had something to do with the production of these vast quantities of animalcules, which never fail to be found where the least amount of dead vegetable matter has been allowed to rest in still water. Extensive seas of fresh water, commingled with decaying forests, or which had passed over such, would be the birth place of our fossil Infusoria, the remains of which, as generation after generation perished, would sink in an impalpable powder to the bottom, and there in time be accumulated in the form of a layer of rock."

The fossil remains of vegetables present most interesting phenomena to the geologist; these have been already referred to and illustrated in the course of the work, and in this place we have only to notice that the microscope affords considerable aid in the development of this class of objects, particularly the fossil woods, specimens of which can now be procured cut so extremely thin as to admit of their being viewed by transmitted light, by which means all their peculiarities of structure can be readily ascertained. We shall lay before the reader Mr Pritchard's eloquent and philosophical remarks on this subject:—"To the botanist the aid of the microscope is indispensable. In the investigation of our fossil-flora, what does it not exhibit to us! How beautiful and delicate is the structure of the envelope of some of the fossil-fruits; those, for instance of our London clay, when viewed under this instrument! And how important is it, that, by its assistance, we can determine with accuracy the natural orders, genera, and sometimes the very species of the trees and plants of former epochs! How, beyond all question, is now demonstrated the vegetable origin of our coal! Preserved within a bituminous lump of coal, which has been deposited for thousands of years deep in

the bowels of the earth, you may discern not only the woody fibre, its arrangement, and the disposal and form of the medullary rays, but even the most delicate of the vegetable organs, such as the spiral vessels and the beautiful terminations of those vessels! These are distinctly discoverable as in the finest preparations of a recent plant. And what can be more amusing and instructive than the examination of the silicified woods, when formed into sections no thicker than the paper of a bank-note? Thus rendered pervious to light, the organic structure of the wood becomes plainly distinguishable. And emanating from this, what can be a more interesting subject than the inquiry into the mode in which the silicifying process has been carried on—by which the constituent elements of the inmost and minutest portions are changed—whilst their form and situation and colour remain the same? In investigating also that extinct genus of plants, the Lepidodendra, a similar idea is raised in the mind, as to what must have been the particular state of the earth with respect to atmosphere and temperature at the period of their growth, and what the changes which have since taken place, in order to bring it to its present condition."—"In the foregoing remarks on the application of the microscope to botanical purposes, I have given the reader only a general outline; to enter upon any thing like details, would of necessity extend our introductory chapter of this description far beyond its proper bounds. I may, nevertheless, be permitted to make use of one example by way of illustration. But how shall I select one where the materials suited to construct it are so superabundant, and where they all present so many points of interest? It will be readily admitted that this is by no means an easy choice. I will limit my observations, however, to a single microscopic slider, and see what instruction is derivable from it. Suppose this slider to contain some sections of a fossil wood; for instance, three specimens or shavings of such extreme tenuity, that if they were exposed, they would be wafted away on the slightest breeze. Let them be weighed, and they will not exceed a grain. Hand them to the chemist, and he can only prove to you that their primary constituents are oxygen, hydrogen, carbon, &c., and in so doing, he will destroy them. What, then, does an inspection of them under the microscope reveal? It will tell you, in the first place, whether they grew up, like our forest trees, by yearly additions to the outside of their woody centres, or by internal accessions, like most of the productions of the tropics. It will tell you whether their leaves were veined or not—whether their embryos were dicotyledons or monocotyledons—whether the trees from which they were cut had branches or not—and, if they had, whether these were thick and sturdy, like the boughs of the oak; or thin and flexible, like the branches of the fir tribe. It will tell you whether the wood might be easily cleft asunder, like deal; or would sooner break, like beech; whether it was elastic, like the pine—so admirably suited for the masts of ships; or like the stubborn oak, would rather snap than yield to the wind. These are some of the ordinary properties developed by the microscope. Again, in taking a more minute physiological survey, our information will be by no means less complete. For these same specimens will disclose to us, under the microscope, the form and arrangement of their woody fibres, the disposition of their barks, the beautiful structure of the tubular receptacles by which their secretions have been carried on, and their growth promoted. In short, so much will be revealed by them in this manner, that the actual distinction between a wild and a cultivated tree may be, in some cases, clearly traced."[1]

We now proceed to the second branch of our subject, namely, the consideration of the minute formations and phenomena of the *Vegetable Kingdom*. Here opens a rich field of interesting observation, and the more interesting because it embraces an extensive range of objects with which readers in general can claim familiar acquaintance, so far as their features are obvious to the unassisted eye. It would, we venture to say, be difficult to find a person, young or old, who, in his rural walk, has not stopped to look upon the broad and massive foliage of the oak, or rested beneath the shade of its far spreading branches,—who has not gathered the wild flowers that embroidered his sylvan couch, and wondered at their surpassing loveliness,—or has not lingered with pleasing delight amidst the luxuriant display of vegetable beauty in the carefully tended flower-garden. And to those who look with admiration on trees, plants, and flowers, as they exhibit themselves to the unaided sight, and in a passing glance, it cannot be uninteresting to know that under these obvious beauties lie concealed formations so exquisite, and mechanical powers so wonderfully contrived by the great Artificer of nature to produce, sustain, and carry on the vegetable organization, that, wanting a knowledge of these, we can scarcely be said to know anything of the vegetable creation. And here again we call Mr Pritchard to our aid:—"Vegetable organography," he observes, "upon which the modern botanist depends so much for his systematic arrangement, and

[1] *Pritchard's Microscopic Illustrations*, New Edition, pp. 21 and 25.

ch which the student is so greatly interested, and amused, owes almost its very existence to the microscope. This observation will be found to apply in an especial manner both to the cellular and vascular tissues of plants. The membraneous cellules of cellular tissue are sometimes not more than 1-1000th of an inch in diameter; and those of the ordinary size, are about 1-200th or 1-300th. How then is it possible that we could become acquainted with their forms and arrangement but by the aid of the microscope? And so with respect to vascular tissue: it is absolutely indispensable toward acquiring an accurate knowledge of the structure and forms of these membraneous tubes, and of the spiral, or annular, fibre that surrounds them. A knowledge of the fructification, if I may so express myself, of that numerous and curious class of plants, the Acrogens, could not be obtained without it; nor could the existence of many of them, such as the Fungi, Algæ, and some of the Musci, be proved. By its powers, even the ashes of vegetables may be seen to contain the decisive characteristics of organic structure; and the long debated question of the antiquarian whether the "fine linen of Egypt" in the times of the Pharaohs, was of linen or cotton fibre, seeing the latter is now indigenous to that country, is for ever set at rest."

But, not to insist in this place on the aid afforded by the microscope to the professed botanist or the scientific inquirer, let us glance at those simple yet highly interesting and pleasing observations, which appeal so forcibly to every one who has a mind constituted to relish and enjoy the beauties of nature. In an ordinary survey of flowers, we found our admiration on the beautiful shape and texture of the petals, their number, colour and arrangement; and the singular or striking disposition of the stamina and other parts reposing in the cup of the blossom. But when we take a single flower and subject it in detached parts to microscopic examination, what a fund of pleasing knowledge is opened to us! The velvet surface of the petals is resolved into a fabric which no human art can imitate; and the stamens and adjacent parts when examined in detail, exhibit formations which could not have been conceived to exist in so small a space. Every flower has microscopic beauties peculiar to itself; and it would occupy the leisure of an extended life, to make one minutely acquainted with the floral products of the humblest village garden. Then, again, what a variety of shape and character is to be observed in seeds; some with beautiful shining surfaces, others most singularly marked and figured, or strangely peculiar in form, or provided with curiously wrought appendages,—yet all strikingly adapted to further and assist the reproduction of the plants to which they respectively belong. The fibres, veins, peculiarities of surface, &c., of the plant leaves demand careful investigation; and the young wood of the shoots is likewise worthy of being minutely examined. A thin transverse section of the latter discovers under the microscope a structure resembling, but far surpassing, the richest lace work. It is time, however, to leave these desultory remarks, and proceed with our subject in an orderly manner.

We have before alluded to the active molecules of matter in connection with the mineral kingdom, and we are now briefly to notice the same phenomenon of atomic activity in vegetables. Indeed, it was during a course of experimental observations on the latter substances, that this phenomenon was first witnessed by Robert Brown, Esq. F.R.S. Having found that the *pollen* of plants, when suspended in water, exhibits a most remarkable activity, evidently resulting from other causes than the agitation of the fluid or the breath of the observer, he naturally concluded, that the minute particles of inorganic bodies might present similar appearances, if similarly suspended.[1] This conclusion is proved to be correct. So far as the writer has observed, there is no difference between the motions of mineral and vegetable molecules, beyond what may be explained by the different principles on which these two species of atoms are presumed to combine, for the formation of inorganic and organic bodies. Our space will not permit us to speculate on this point of identity between the vegetable and mineral kingdoms; it must, however, strike the reflecting reader as a remarkable circumstance, that the minutest atoms of vegetable and mineral bodies are controlled by one common law; and he may be led to the inference that probably organic and inorganic bodies are produced by one and the same principle, modified by secondary agencies. There is, notwithstanding, this broad and decisive distinction between organic and inorganic structures; the former are mere aggregations of atoms, the latter are laboratories, in which complicated operations are continually going forward to prepare matter, so that it may assimilate with and enter into their constitution.

The circulation of the fluids in plants seems to link them with animal existences; but we find, on close examination, that the motion of vegetable fluids differs widely from that of the blood. Blumenbach observes;—"However varied the reticular and other connections of the vessels may be, no relation can be

[1] This molecular activity is exhibited, not in the vegetable dust, palpable to the naked eye, and usually named the pollen, but in the particles of the true farina hereafter to be noticed.

detected between them, of such a nature as to keep up a circulation of fluids, such as is found in all red-blooded, and so many white-blooded animals." Most probably what is termed the circulation in plants is nothing more than the nutritive juices proceeding through capillary vessels to all parts of the plants, whence they do not return. The reader may, however, choose to hear Mr Pritchard's remarks on this subject, the more particularly as they are the result of careful observation with the finest instruments that can be constructed.—"The circulation in plants, termed *cyclosis*, is a *revolution* of the fluid contained in each cellule, and is distinct from those surrounding it. It can be observed in all plants in which the circulating fluid contains particles of a different refractive power or intensity, and the cellules are of sufficient size and transparency. Hence all lactescent plants, or those having a milky juice, with the other conditions, exhibit this phenomenon. The following aquatic plants are g nerally transparent enough to show the circulation in every part of them :—Nitella Hyalina, Nitella translucens, Chara vulgaris, and Caulinia frigalis. In the Frog-bit (Hydrocharis) it is best seen in the stipulæ of the leaves and the ends of the roots. The magnifying powers suited for the above are between 100 and 250 times linear. In the Spider-wort (Tradescantia virginica) it is seen in the filaments surrounding the stamens of the flowers: power required, 300 to 500 times linear. In the common groundsel (Senecio vulgaris) it is said to be seen in the hairs surrounding the stalks and flowers."

The respiration of plants is another feature in which we trace a similarity between vegetable and animal bodies. The leaves in plants answer the same purpose as the lungs in animals, "for the execution of the phlogistic process, which in the latter, is effected principally by the inspiration of the respirable part of the air on its basis, oxygen; and which, in plants, is performed almost exclusively by the leaves. In plants also, this respirable gas, or its basis, is, as in animals, indispensable to the support of life; particularly as Ingen-Housz's experiments have rendered probable, for the purpose of preparing in their vital laboratory their principal material of nutrition, carbonic acid, the excess of which they subsequently exhale in the form of carbonic acid gas. This important process is carried on in its greatest activity in the dark. During the day-time, on the contrary, and particularly in sun-shine, it is much more languid: hence at such time, plants prepare and consume carbonic acid in smaller quantities; and, on the contrary, evolve oxygen, the respirable part of the atmosphere. from their leaves." By the assistance of the microscope we discover, in the cuticle on the under side of the leaves, a number of small openings, termed *stomata*, which are considered subservient to the respiration of plants, as well as to the exhalation of the fluids which are evaporated from them in considerable quantities. It is worthy of remark with reference to the evaporation of moisture, that this process is as necessary to vegetable, as that of perspiration is to animal life; for if the stomata of the leaf be closed up artificially, or otherwise, the plant, or that immediate part of it, becomes diseased and withers. The alternate exhalation of oxygen and carbonic acid gas from the leaves of plants, must appear a remarkable provision, subservient to the health and comfort of man. During the day, when mankind are in activity and requiring a full supply of respirable air, the plants, in place of taking from, add to its healthy qualities; and when, at night, the human race are wrapt in slumbers, and the functions of the animal body are performed with less activity, and when consequently less oxygen is required to carry them on, the plants, in turn, take in their supply of this gas, evolving it again with the morning light for the benefit of the awakening world.

Let us notice a few of the interesting facts ascertained from a microscopic examination of a flower. We will begin with the petals, or leaves, which surround and protect the reproductive organs of the vegetable, and constitute the largest portion of the flower. The upper and under surface of these are first to be examined, and the disposition of the downy covering, or spines, or other remarkable features, carefully noted. If then we are able to separate the cuticle on the under side, it will discover to us the *stomata;* and the removal of the cuticle exposes the absorbents of the petal, whose use is to absorb the elements of vegetable nutrition from the atmosphere. Strip off the remaining petals from the flower, and leave only the reproductive organs on the receptacle, or base. Take one of the stamens and carefully observe it; it consists of two parts, the *filament*, and the *anther*. The former of these is found to be a capillary tube for the conveyance of nutrition to the anther, a variously shaped body placed on the summit of the stamen. The anther is the principal object of regard. When submitted to microscopic examination, a number of minute particles are seen scattered over its surface, but if it be pressed, and its interior displayed, the particles become innumerable;—these are, what is usually termed, the pollen or fertilizing dust necessary for the impregnation of the pistil, or female organ of the blossom. They exhibit a most wonderful variety of structure in different flowers, and have always been objects

of great interest to the microscopic observer. Plate 34, fig. 28, is the pollen of the marsh-mallow, consisting of small globes thickly studded with prickles. These atoms are not, however, the actual farina; for on examination with deep powers they are found to be delicate little bags, containing an inconceivably fine powder, the true vegetable semen. The pistil is the next object for observation: it consists of three parts, the *germen*, the *style*, and the *stigma*. The style is a hollow tube, forming a communication between the other parts of the pistil; the stigma is usually a small bulbous substance supported by the style; and the germen is the lower extremity of the pistil, reposing within the corolla of the flower. At the time of fecundation the farina falls on the stigma, whence it is presumed to pass through the style to the germen, the seeds in which thus become impregnated and indued with vegetable vitality. The stigma in some flowers is either divided, or has a small opening which contracts and expands at intervals; in others this organ exhibits a porous surface; in either case it is suitably constructed for the office it fulfils. The germen is the most remarkable part of the pistil, answering to the ovaries in animals. If the outer covering be carefully removed, the seeds will be discovered, clustered like grapes, and a considerable difference of formation will be observed in the germen of different flowers. We have here slightly glanced at a few leading facts elicited from a microscopic examination of blossoms; and in connection with them, we would mention the singular means by which the impregnation of the pistil by the farina is frequently effected. Some flowers are hermaphrodite, and contain within themselves both the male and female organs of reproduction; others are either male or female. "The motion which is observed at the time of impregnation in those flowers which unite the sexes is very remarkable: thus, for example, the stamina of the common barberry, when touched on their inner side, (that turned towards the germen) as may happen when an insect settles on the flower, to suck the honey from its basis, suddenly move inwards, and strike their anthers against the stigma, by that means effecting the fecundation." When the organs are in separate flowers, and, as is the case with the hop, hemp, &c., on different plants, the farina will frequently be carried from the stamen of the male flower to the stigma of the female, by the honey bee, which visits the various blossoms to collect their sweetness, and almost invariably bears away on its wings and body a portion of the farina from one flower, and unconsciously deposits it on the stigma of another. There are other means of impregnation in these cases, more obvious; such as the agency of the wind, or the actual deposition by the florist of the farina on the female organ.

When the impregnation of the germen is effected, all the superfluous parts of the plant fall off, and the former increases in size till the seeds contained in it have reached maturity. "The form, as well of the different seeds, as of the coverings in which they are inclosed, is as various as that of the flowers, and adapted in the most admirable manner to the preservation of the species as regards their extended dispersion, their security, &c. The provision, too, is remarkable, by means of which, whatever may be their position in the ground, when they germinate, they invariably shoot their radicle downwards, and the plumula upwards." The principal parts of a seed are the *cotyledons*, or seed-lobes, which after germination become leaves, and the *corculum* or heart, consisting of the radicle and the plumula. Seeds require, in general, to be prepared for microscopic examination, by steeping them in hot water, when the several parts just named separate and discover their respective formations. The exterior of many seeds is, however, so remarkable, that without any preparation they are most interesting objects under every power that will afford light sufficient to develope their structure. To attempt a description of all the varieties, is impossible; we must simply refer to some of their singular appendages, and describe a few whose formation is most striking.

The *pappus*, or down, with which many seeds are provided is a wonderful characteristic, whether we regard the structure of the down itself, or the ends it is intended to serve. Plate 34, fig. 9, exhibits a filament of thistle down, as it appears under a linear magnifying power of 80. This down, with some variety of form, is either placed on the top of seeds in the manner of a crown, or on each side like wings, or it covers the entire surface; in any case the purpose is much the same, namely, to provide the seed with means of transit from the seed-case to the spot of earth on which it is destined to fall and germinate. And to this wonderful contrivance of nature for the propagation of vegetable life, we are to attribute much of the verdure and floral loveliness of those wild, sequestered spots, where the cultivating hand of man has never been employed, and where the human foot has rarely trod. The down is sometimes designed as a protection to the seed; it either repels the moisture which would injure it, or prevents undue pressure from contiguous bodies. And in some cases, it is so disposed, that it not only directs the seed into a proper position for germination, but also, if the seed be placed in the earth with its plumula downwards, will work it up to the surface again, and re-de-

posit it with the plume upwards! The only other appendage to which we shall refer, is the *ala*, or wing, a fine membrane attached either to the back or margin of certain seeds. On a microscopic examination, this does not appear to be intended so much for a means of transit, as for absorbing nutriment to facilitate the germination of the seed. It is, in most instances, a layer or reticulation of capillary tubes, protected by a double membrane.

The conformation of poppy seeds is exceedingly curious. In outline they somewhat resemble a kidney, and their surfaces are divided into angular compartments, by means of reticulated fibres connected by an exceedingly thin and transparent membrane. Plate 34, fig. 29, is the seed of the Calampelus Scaber, in which the ala, or wing, is a characteristic feature; the external tunic, or outer integument of the seed, is also worthy of observation. Fig. 30, represents a seed of the French Marygold; and in this we notice the wing-like disposition of the down before adverted to. Had the object been sufficiently magnified, this down would have exhibited the character of fig. 9. It is barbed, or spinated; and whilst it serves as a vehicle for the transit of the seed, it also controls its position when placed in the earth, as previously stated. Fig. 42, exhibits the *Theca*, or seed vessel of Moss, under a superficial magnifying power of 100. Without the aid of the microscope, the fructification of the mosses could never have been understood. Botanists are now enabled to distinguish the various genera, by observing the character of the fringe round the mouth of the seed-vessel, and the peculiarities of figure in the seed itself. The powder, or seed, of Puff-ball, a species of Fungus, is an object of great interest, under a high magnifying power. Baker describes it in these words:—"The seed of the Puff-ball seems to the naked eye like a smoke or vapour; but when examined by one of the greatest magnifiers (for else it cannot be distinguished) it appears to be infinite numbers of little globules, of an orange colour, somewhat transparent, whose axis is not above the fiftieth part of the diameter of a hair: so that a cube of a hair's-breadth diameter, would be equal to an hundred and twenty-five thousand of them." The same author's remarks on the seed-vessels of ferns, the second order of Cryptogamian plants, agree with recent observations. "The ancients," he says, "imagined the capillary plants and many other kinds to produce no seeds at all, but the microscope has discovered that all the several species of fern are so far from being barren in this respect, that they are amazingly fruitful: that the seed-vessels are on the backs of the leaves, and that the dust which flies off when we meddle with them, is nothing but their minute seeds. These seed-vessels appear to the naked eye like a black or brown scurf on the back side of the leaf; but, when viewed by the microscope, resemble little circular tubes, divided into many cells, containing seeds. When the seed is ripe, the vessels fly open with a spring, and spirt the seeds out on every side, in the form of dust: and if at that season some of the leaves are put in a paper cone, and that be held to the ear, the seed-vessels may be heard to burst with a considerable noise. Some of these minute vessels contain at least one hundred seeds, invisible to the naked eye. Fig. 33, shows the pod and seed of a kind of fern, named polypodium, that vegetates on the bark of the oak. The seeds contained in each pod correspond in number to the divisions on its circumference. The figures exhibit all the details observed under a superficial magnifying power of 40,000."

The plant, or tree leaves, require to be considered distinctly from the petals of the blossom; for though the two have some things in common, the latter affect the flower only, whilst the former are organs on which the health and vitality of the whole vegetable structure principally depends. We have already adverted to the cuticle, stomata, and absorbent vessels, and the important offices they fulfil; the other points of microscopic interest are included in the following observations by Blumenbach. "The leaves are essentially the same in composition with the trunk and branches, inasmuch as it is possible to distinguish in them cuticle, bark, woody substance and medullary cellular structure. The latter occupies the middle of the leaf, between the two reticular layers of woody substance, from which the other parts may be removed by corrosion and similar processes, leaving a skeleton leaf, as it is called. This reticular woody substance is covered on both sides of the leaf with a peculiar membrane, generally called cuticle, but differing materially from the proper cuticle already mentioned, (which is really expanded over the outer surface of the leaves,) and penetrated by numerous absorbing vessels."

We extract some interesting remarks concerning leaves, from an author before quoted;* and the reader will admire the acuteness with which he has anticipated the comparatively recent discovery of the *cyclosis*, or circulation in plants.

"The leaves of trees or plants are full of innumerable veins and ramifications, that convey the perspirable juices to the pores, for their discharge. Whether or no there be any circulation in them is still a matter of doubt; but as their juices, when let out, immediately

* Baker. The Microscope made Easy, p. 246.

break, coagulate, and become a stiff jelly, it seems probable there may be some circulation which prevents the same effects in the vessels. The sudden shrinking, closing, and opening of flowers, the rising and sinking of the heads of poppies, &c., the vermicular motions of the veins of plants when exposed to the air, seem also to imply somewhat like sensation. The microscope may perhaps be of service to discover much more on these subjects than we yet know. Mr Leeuwenhoeck tearing to pieces a leaf of the species of box called *Palma cereris*, that he might examine it the better, computed one side of it to be furnished with one hundred and seventy-two thousand and ninety pores; and as the other side must have as many, (?) the whole number of pores in a single leaf of box will be three hundred and forty-four thousand, one hundred and eighty. The leaves of rue seem full of holes, like a honey-comb; all the kinds of St John's wort appear likewise struck full of pin-holes to the naked eye; but the microscope shows that the places where those holes seem to be, are really covered with an exceeding thin and white membrane. The under side of the herb Mercury, looks as if rough cast with silver, and the ribs full of white round transparent balls, like numberless grapes, fastened by slender foot-stalks. A sage leaf appears like rug or shag, full of knots, tasseled with silver thrums, and embellished with fine round crystal beads or pendants, fastened by little foot-stalks. The under side of a rose leaf, but especially of sweet-briar, looks diapered with silver."

"Every body knows that the leaves of stinging nettles are thick set with sharp prickles, that penetrate the skin when touched, and occasion pain, heat, and swelling: which symptoms were imagined, formerly, to ensue from the prickles being left in the wounds they make. But the microscope discovers something much more wonderful in this common vegetable, and shows that its prickles are formed and act in the same manner as the stings of living animals. For every one of them is found to be a rigid, hollow body, terminating in the most acute point imaginable, with an opening near its end. At the bottom of this cavity lies a minute vessel or bag, containing a limpid liquor, which, upon the least touching of the prickles, is spirted through the little outlet; and, if it enters the skin, produces the mischief before mentioned by the pungency of its salts. Hence it comes to pass, that when the leaves of the nettles are considerably dried by the heat of the sun, they sting but very little; whereas such as are green and juicy, produce violent pain and inflammation. But the quite contrary to this would happen, if the symptoms were only owing to the breaking of the prickles in the flesh: since when dry, they must be more brittle, as well as more rigid, than when they abound with juice." Our author concludes his remarks by suggesting this query:—"Are there any valves in the vessels of vegetables, as in those of animals, to let the juices pass, but hinder their return?" To this inquiry we believe no answer has yet been returned by any subsequent observer; it is scarcely necessary to say that it is deserving of patient investigation.

We must now briefly glance at the general structure of those cryptogamian plants, whose parts are too minute to be distinctly seen by the naked eye. Of these plants there are four Orders:—the Ferns, the Mosses, the Algæ, and the Fungi.

The most remarkable features in the *ferns*, namely, their seed-vessels and seeds, have already been noticed. The seed-vessels are termed *capsules*, and are usually surrounded by an elastic ring; the seeds themselves are named *sporules*. These are objects that require considerable magnifying power to develope them. The leafy stem of the fern (the *frond*) is an object of great interest when viewed on the under side, which exhibits all the seed-vessels arranged in regular dotted lines.

The *mosses* are a numerous family of very minute plants. "They are supposed to be devoid of woody fibre and vascular tissue. When a leaf is carefully examined, the *septa* which divide the different cells that compose it, will in many species be found to consist of a single spiral line, taking a spiral course from one end of the cell to another. To observe this, it will be advisable previously to soak the moss in water, in order to expand the cells. In collecting mosses, it is essential to procure them with the theca (before noticed and illustrated,) "as without it, it is very difficult to determine the genera to which they belong." Plate 35, fig. 37, is a leaf of *sphagnum*, more usually known under the name of bog-moss. By reflected light, and when laid on a dark-coloured stage, it appears delicately white, and the fibrous structure of the septa is readily perceived. When viewed by transmitted light, the regularly disposed hexagonal cells present the appearance of delicate tracery, or lattice work. It is here shown under the low power of 100 on the surface. "Mosses of all kinds are agreeable objects, and appear, by the microscope, to be as perfect in their leaves, flowers and seeds, as the largest plants or trees. Those, particularly, that grow on the rocks and coasts of the sea, exhibit amazing beauties." The order, named *algæ*, includes the lichens, fuci, and confervæ; and those exceedingly minute vegetations which compose the green matter on unfrequented paths, and also the various kinds of mouldiness, may be placed

under this order. The lichens grow on rocks, the trunks of trees, old palings, &c., and are more usually known by the names of wall-moss and tree-moss. Their generic distinctions are founded on a microscopic examination of their organs of fructification, which commonly resemble little cups or shields. The fuci (or sea-weeds) form a most interesting class of microscopic objects; there is a wonderful variety of them, and the structure of every genera is either exceedingly beautiful, or singularly curious in its details. Plate 35, fig. 38, exhibits a species of sea-weed, under a superficial amplification of 100. The confervæ are aquatic vegetations consisting of capillary tubes only, and in many of them the mode of propagation is extremely simple: in the *conferva fontinalis*, it consists merely in "the enlargement of one end of the thread-like plant into a globular ball, which afterwards falls off and expands into a thread of the same kind." The confervæ include the genera *Chara*, and *Nitella*, in which, as before observed, the cellular circulation is distinctly seen. The appearances presented under the microscope, by the different kinds of mouldiness is most remarkable. Every species is resolved into a perfect plant, "bearing," says Baker, "leaves, flowers, and seeds, and increasing in a manner almost incredible: for in a very few hours the seeds spring up, arrive at full maturity, and bring forth seed themselves; so that a day produces several generations of them." The usual form of these minute plants consist of a capillary tube, the stem, and a small round head, the fruit or seed vessel; this latter ripens, bursts open, and scatters the seed around it. The *fungi*, of which the common mushroom is a representative, "consists of plants mostly of a spongy or cork-like texture; they are generally of short duration, and bear their seeds in gills or tubes, or attached to fibrous or spongy substances. Their generic characters are taken from the disposition of their seeds, or from their external figure or appearance. The greater number of the fungi are indigestible poisonous matter, and the edible mushrooms ought to be collected with care."[1] Mr Pritchard observes,—"their structure is simple, and mostly consists of cellular tissue, in which the minute seeds or sporules are disposed. They are found in all damp places in which there is not a free current of air." Before the invention of the microscope, it was believed that the various kinds of fungi "might be generated at any time, and from any kind of putrified substance, either animal or vegetable, *without seed;* merely by the friendly concurrence of either natural or artificial heat and moisture." In reference to this opinion, an old micrographer justly remarks:—"It must be owned, that heat and moisture, and oftentimes a degree of putrefaction in the substance, are requisite to make these little plants thrive; but that such principles should be able to create them, must, I think, be past belief." The destructive fungi of wood, (*merulius destruens* and *vastator*,) more popularly known as the *dry rot*, are singular microscopic objects when examined in detail; as are also the *uredo segetum*, &c., which cause rust, smut, &c., in grain, and whose fructification consists in a mealy powder, under the cuticle of the plants.

With a brief mention of the microscopic phenomena exhibited in the woody formations of trees, shrubs, &c., we shall conclude our survey of the vegetable kingdom. "The stem of trees and shrubs is covered externally with a very fine cuticle, (rind,) under which lie the bark and the liber (Bass,) the latter consisting almost entirely of the most active sap vessels, and consequently, one of the parts most essential to the support of the plant. Placed more internally, is the alburnum (sap;) next to it is the true wood, and next, the medulla (pith) partly within the interstices of the wood, partly down the middle of the stem; its quantity gradually diminishing as the age of the tree increases. In plants of this kind too, one, or more properly, two new layers of wood are produced yearly, probably by the alburnum, whence it is possible, from the number of such concentric layers, to form an estimate of the probable age of the plant. The wood of palms forms an exception to this disposition, in which no such concentric layers exist, the trunk being equally dense throughout, very hard, and apparently traversed by partial tubes of alburnum. This circumstance is of importance in assisting the decision as to the nature of fossil woods." In thin transverse and vertical sections of woods, (such as are prepared by Mr Pritchard for the gratification of the microscopic observer,) all, or the greater part, of the characteristics above named, are clearly distinguishable under a moderate magnifying power. The great points of inquiry and examination in this class of objects, are the form and disposition of the *cellular tissue*, *woody fibre*, and *vascular tissue*. "The *cellular tissue* composes the pith and soft parts of a tree or plant; when minutely examined, it is found to consist of distinct vesicles of various forms cohering together: they vary in size from 1-30th of an inch to 1-600th; the largest are found in aquatic plants and in the gourd tribe." This cellular tissue, or the vesicles of which it is composed, is filled with the nutritive juices of the plant, whether absorbed by the bark or furnished by capillary tubes from the root; and in these small reservoirs, it is probable,

[1] See Botanical Chart in the Popular Encyclopedia.

the fluids undergo a preparation for the purposes they are to serve. "The *woody-fibre* is best observed in the vertical sections, cut either parallel or perpendicular to the medullary rays: it consists of slender tubes gradually diminishing towards the ends. The fibres vary greatly in diameter; the largest are in the coniferæ: in the lime-tree they often exceed 1-50th of an inch. The *vascular tissue* consists of membraneous tubes, with conical extremities, internally furnished with fibre. When the fibre consists of one or more threads coiled spirally like a screw, it is called a *spiral vessel;* when the fibre consists of rings, it takes the name of *annular vessel;* and if in small pieces, *ducted vessels*, either *reticulated* or *dotted.*" The vascular tissue of plants acts in concert with the cellular tissue for the collection and preparation of the nutritive fluids. Our microscopic knowledge of the economy of vegetable organization, is far from being complete; and, perhaps, at present we can do little more than express our admiration at the wonderful operations which *must* be continually going forward in that laboratory, the trunk or stem of a tree. "Every tree," Adams observes, "may be considered as consisting of numerous concentric strata or flakes, forming so many cones, inscribed one within the other, and whose number is almost indefinite. The most exterior contain the rudiments of the bark; the more interior, those of the wood. In the germ they are gelatinous, by degrees they become herbaceous, and in process of time assume the consistence of wood. Thus the stem, the root, and the branch, may be considered as formed of a prodigious number of concentric vertical strata, each composed of different fascicles of fibres; which fibres are again formed of smaller ones. The spaces between these, and among the fibres, are filled up, interwoven with, and connected by the cellular tissue, of which the radial insertions are formed."

Plate 35, fig. 39, exhibits the singular formation of the aloë as developed in a transverse section, under the amplifying power of 100 on the surface. This object discovers the character of cellular tissue in a very pleasing manner.

Fig. 40, shows the fine longitudinal fibres of the palm, under a superficial power of 90,000.

Fig. 49, is a transverse section of the clematis, showing, under a superficial power of 400, the wonderful arrangement and exquisite structure of its tissues.

We come now to consider the minute formations and phenomena of the *animal kingdom.* A large volume would scarcely suffice for a particular and detailed examination of animal minutiæ: all therefore, that we can propose to ourselves in a division of a single chapter, is to take a general and comprehensive survey, particularizing only in a few instances by way of illustration.

We commence with a slight notice of the *bony structures* in animals. These are brought under microscopic examination, in the same way as the cuttings of wood; viz. by obtaining extremely thin vertical and transverse sections, which are to be viewed both in a dry state and moistened with water. We are instantly struck with the resemblance between them and vegetable formations: in the transverse sections we observe the cavity formerly occupied by the marrow, answering to the medulla in plants; the perforations, resembling cellular tissue; and the concentric circles, indicating the process by which the structure is enlarged. In verticle and oblique sections the vegetable analogy is still preserved, in the disposition and character of the fibres. The *muscles* of animals are to be examined in like manner; by cutting thin slices of dried flesh in various directions, and viewing them first in their dry state, and afterwards when saturated with water. The formation of the fibres and muscular vessels, (the latter much resembling the vascular tissue of plants,) is worthy of attentive examination; it is not, however, the mere beauty or singularity of formation that renders them interesting, for from a microscopic investigation of these structures we are enabled to infer with certainty concerning the strength and activity of the animals to which they respectively belong. The *horns*, *hoofs*, *nails*, &c. of animals form a class of objects that are brought under view in the same manner as the preceding. Thin slices cut in two or three directions exhibit the fibres and cellular cavities; and a vegetable structure is farther evidenced by treating them as opaque objects, and observing the character of the exterior. If, for instance, the outer surface of the human nails be attentively examined, it will be found to consist of a vast number of layers; and if we take a hedgehog or porcupine's quill (the structure of which is the same in principle with that of the nails, hoofs, &c.) we shall discover the true nature of these layers, which are, in fact, conical cups shooting successively one out of the other. Plate 34, fig. 27, exhibits a transverse section of a hedge-hog's quill, wherein we see a medulla or pith, cellular cavities, and other vegetable characteristics. We perceive, then, a wonderful analogy in these structures to the woody formations of trees, both in the infernal disposition of parts, and the exterior accessions arising from progressive growth. The *hairs* of different animals are very similar to the horns and nails, &c. inasmuch as they consist of cups inserted within each other, and interiorly exhibit, (so far as micrographers have

succeeded in examining transverse sections,) nearly the same vegetable characteristics. In general, however, the cups are more readily distinguished in hairs than in the nails, or porcupine's quills, and other objects of this class; there is also a much greater variety of structure in the former than in the latter. Plate 34, figs. 1 to 7, exhibit some interesting varieties of hairs, of which we shall speak in order. We give no illustration of the human hair, because in the adult its character is so much defaced by friction, that it exhibits, even under a deep power, little more than the appearance of a polished cylinder. In the hair of an infant newly born, the serratures on the sides, or more properly, the cup shaped processes, are readily distinguished; we had not, however, when engaged on our drawings, an opportunity of procuring a specimen. Hairs may be described *generally* as cylindrical bodies, composed of a vast number of minute fibres, with cellular cavities interposed; some have spiral lines running up the interior; and from observation of a few varieties, it may be inferred that all are furnished with an apparatus resembling the stomata in the leaves of vegetables. We proceed at once to describe the figures before referred to.

Fig. 1. *The hair of the Dermestes.*—This insect belongs to the order coleoptera, and is remarkable for the beautifully formed hair which covers it in the larva state. There is a variety in the structure; some of the hairs resemble an oat beard, and others exhibit the character shown in our specimen. A more delicate and beautiful object than the spear-shaped hair can scarcely be submitted to the microscope. The lowest power by which it can be seen, is 100 linear; but to develope its details satisfactorily, a power of 200 linear is requisite, which is the one we have used. This object is considered an excellent test of the defining power of a good microscope.

Fig. 2. *The hair of a mouse.*—The characteristics of this subject, when viewed by transmitted light, are dark, transverse stripes, some of which are broken, whilst others extend quite across the hair. On closer and more attentive observation, these appearances are discovered to arise from a kind of spiral spring occupying the tube of the hair, and a number of imperforations on the surface.

Fig. 3. *The hair of a bat.*—From the resemblance between the mouse and the bat, it will excite a little surprise to observe the very decisive difference of structure in the hairs of these two animals. That of the latter sometimes presents the appearance of a screw, or of a number of small conical cups inserted into each other; other specimens seem to be formed of two distinct hairs twisted together; and some exhibit in connection with these peculiarities, striped markings resembling those on the hair of the mouse.

Fig. 4. *The hair of a bee.*—This is a very beautiful object, but requires a good defining power to show the structure satisfactorily. The hair itself resembles a jointed bamboo cane; and from each joint small delicate spines shoot out. The hair terminates in a number of these spikes, one of which is uniformly longer than the rest.

Fig. 5. *The hair of a dormouse.*—This is very similar to the hair of a mouse. The points of difference seem to consist in the regularity of the stripes on that of the dormouse, and its greater delicacy.

Fig. 6. *The hair of a mole.*—This is a most singular structure. The interior exhibits the remarkable transverse stripes observed in the hair of the mouse and dormouse, and the exterior presents a formation somewhat resembling that of the bat's hair.

Fig. 7. *The hair of a caterpillar.*—We notice a great similarity between this object and the hair of a bee. The tube of the hair is not jointed, however, in the caterpillar, and the lateral spines curve the contrary way.

These objects are all shown as developed by a doublet linear power of 200.

The next animal appendage to which we shall allude is the *feathers* of birds, wherein we notice very distinctly the same degree of analogy to vegetable formations, as is found to exist in the hair, &c. The microscopic inquirer is frequently called upon to pause and admire the wonderful adaptation of parts in the various structures he examines; and to note the absolute dependency of the largest formations on the microscopic elements of which they are composed. Let us illustrate this remark in the case of feathers.—The feathers of birds unite to form the wing, a locomotive member which must be light, yet at the same time impervious to air; which must have great freedom of motion, and yet not be liable to permanent disarrangement of its parts. The most superficial observer will have noticed the way in which the feathers are disposed in the wing; they over-lap each other through their whole length, and this principle of over-lapping extends to all the divisions and minute subdivisions of the feathers. Another thing also is too obvious to have escaped notice, that the upper side of every feather is convex, and the under side concave, and that the convex side of one feather lies partly within the concave side of another. This principle of formation likewise extends to the most minute parts. Then again there is an elastic force exerted in every feather, and in every part of a feather for preserving and restoring the natural arrangement. There is, in short, a beautiful display of creative Wisdom in the wing of a

bird, whether we regard the material of which it is wrought, the elegance of its several parts, or the admirable dependency of those parts on each other. A feather consists of three distinct parts—the quill, the stem, and the fibres that clothe the stem on each side. The quill is at once the root of the structure, and a reservoir for the nutriment required to sustain it. The stem is the tree trunk; and the literal fibres are the branches which it puts forth. When we examine one of these fibres microscopically, we find smaller fibres arranged along its edges; and if these last be subjected to a very deep power, we discover that they are, in like manner, fringed with fibres correspondingly minute. The most delicate filaments of the feather exhibit a hair-like structure, being composed of cups inserted one within another; or they present the appearance of a jointed cane. The last named peculiarity is illustrated in plate 34, fig. 8, which shows an exceedingly minute filament of feather down as it appears under a linear magnifying power of 300. The exquisite finish of the joints is very remarkable. We shall offer only one general illustration of the structure of feathers, selecting our specimens from the delicate plumage of the humming-bird, as exhibited and detailed in plate 34, figs. 26, 31, 34, 35, 36. Before entering into a description of these objects, we step aside to notice a remark by Mr Pritchard on the *hair of the bird-catching spider* of South Amercia (*Microscopic Objects*, pl. 9.) "That taken from the palpi is branched, and towards the extremity the central stem enlarges, becomes fluted, and assumes a bright orange colour. The use of this augmentation in bulk towards the end is not ascertained; but I may remark that a similar structure, on a larger scale, may be observed in the small feathers from the breast of the *Indian humming-bird.*" Now from observing a number of these feathers in different stages of developement, the writer was enabled to ascertain the real character of the formations to which Mr Pritchard alludes; and the reader will, we think, be disposed to admire their singular use and remarkable structure. Figs. 31 and 35, are perfect feathers, about one-tenth of an inch in length; the latter exhibits the orange-coloured "enlargements" just named and a number of downy fibres of a pearly-gray tint. It forms a most beautiful opaque object for the microscope; the rich colour of the pods contrasting very pleasingly with the other parts of the feather. Fig. 34, is one of the pods much enlarged; and we call particular attention to the lateral fibres which are escaping from crevices or fissures on each side of the pod. We could have given other illustrations on this point, showing the gradual opening of the pod, and the expansion of the fibres therein contained. Fig. 26, exhibits the ultimate character of the pod when it has burst, and suffered the formation within fully to expand itself. In this state it still retains the bright orange tint. Fig. 31, presents a faithful delineation of the feather when all the pods have opened. The three tufts which terminate each division are worthy of regard; and the beautiful regularity of the whole must excite admiration. It will be noticed that in undergoing this wonderful alteration of form, the feather loses much of the fine downy filaments observable in fig. 35. We should likewise remark, that the perfect developement of the feather is in some degree dependent on the position it occupies on the body of the bird; for we observed several specimens in which the pods gave no sign of opening, though the feathers were as mature in other respects as those which were on the point of full expansion. Fig. 36, is one of the finest fibres of fig. 35, magnified 300 times in diameter. In passing from this brief notice of feathers, we would earnestly recommend the admirer of natural beauty, (if he should be a person with sense sufficient *not to despise small things*,) to amuse his leisure hours by attentively examining the structure of the various plumage that adorns the feathered race.

We proceed to remark upon the *scales* and *perspiratory pores* of the *human skin.* The scarf-skin of the human body is covered in all parts with rows of exceedingly minute scales, disposed three deep, that is, the first line of scales is in a good degree covered by the second, and the second by the third. The whiteness of the exterior skin is probably owing to this triplication of the scales, since on the lips, where they scarcely overlay each other at all, the minute blood vessels shine distinctly. Owing to the constant friction of the hands and feet, and their becoming callous by continued use, it is not easy to procure good specimens of the scales from these members; but from any of the unexposed parts of the body they are readily obtained, by scraping the skin with the back of a penknife. To the naked eye they appear a mass of indistinguishable white-dust; but if they be suspended in a drop of water, which causes them to separate, their true form is very pleasingly developed. Their figure resembles the upper half of a spear's head. To obtain a microscopic view of the arrangement of the scales, cut from between the fingers with a very sharp penknife, an extremely thin piece of the skin and submit it to a powerful magnifier. The shortest diameter of these scales does not exceed 1-1500th of an inch; and their number on a square inch of the human body is not less than one million.

The pores of the skin are minute excretory ducts, discharging the superfluous humours of the body; they also convey to the absorbent vessels of the true skin, the fluid and gaseous products of the surrounding atmosphere. Hence it is, that a derangement of these minute valves, or a suspension of their functions, causes serious injury in the animal economy; and it is almost a demonstrable fact, that all the diseases to which the human body is liable, take their origin from a partial or general interruption to the porous machinery of the skin. It will readily be conceived that great disorders must arise in the system when the exhalation of humours is stopped, and those active agents the absorbents, are inactive. As a preservative of health, nothing is more worthy of attention than this simple precept;—wash the skin clean, remove with flesh-brushes all the scales which are daily shed, and which if suffered to remain upon the skin, mat together and impede the action of the pores; when the perspiration is too scanty, as evidenced by extreme dryness of the skin, use medicines that will determine the humours to the surface; when the perspiration is too profuse, as indicated by an excess on the least exertion, take medicines to moderate the activity of the secretory organs. Here is a volume of domestic medicine in a few lines.

To view the pores, it is necessary with a keen-edged penknife, to shave off the outer surface of the skin as thinly as possible, and then to cut a second piece from the same place; there is no fear of inconvenience from the operation, if it be performed with a light hand, and the skin be taken from between the fingers. The pores are covered by the scales; indeed it would appear that the latter are principally, if not wholly designed, as a protecting covering to these minute vessels. The number of the pores dispersed over the human skin is too large for our conceptions; and when we state, that on the lowest estimate, it amounts, in round numbers, to two thousand millions; we offer this announcement, simply as an effective comment on the scriptural declaration, that "we are fearfully and wonderfully made." The process of perspiration may be pleasingly observed on a warm day, in the following manner:—wash the hands with soap and warm water, and dry them thoroughly, then with a magnifier of one half inch focal distance, observe the small ridges in the palm of the hand, and along the edges of these, the perspiration will be seen arranged like rows of pearls, or more properly, like dew drops on a flower.

The *scales of fishes* are objects of great interest to the microscopic inquirer, from the variety of form and texture observable in them. Exceedingly minute scales have been detected by the microscope lying between the epidermis and the true skin of an eel. We extract a few general remarks on this class of objects from Baker. "These scales are not supposed to be shed every year, nor during the whole life of the fish, but have an annual addition of a new scale, growing over and extending every way beyond the edges of the former, in proportion to the growth of the fish; somewhat in the same manner as the wood of trees enlarges yearly, by the addition of a new circle next the bark; and as the age of a tree may be known by the number of ringlets its trunk is made up of, so in fishes, the number of plates composing their scales denote to us their age. Mr Leeuwenhoeck took some scales from an extraordinary large carp, forty-two inches and a half long, and thirty-three and a quarter in the round, which were as broad as a dollar. These he macerated in warm water, to make them cut the easier; and then cutting obliquely through one of them, beginning with the first formed, and very little scale in the centre, he by his microscope, plainly distinguished forty lamellæ or scales, glued as it were over one another; whence he concluded that the fish was forty years of age." To the arguments here used we have sundry objections to offer: in the first place, the scale of a fish increases exactly in the same manner as a crystal, (say the crystal of common salt), by superposition of thin laminæ, and so far as we have observed, it is as impracticable to ascertain the exact number of layers in the one as in the other; and consequently we can derive from the scales no perfect data whence to compute the age of the fish. And in the second place, the *yearly* addition of a layer to the scale, is nothing more than a mere supposition, from an overstrained analogy. If then, the superpositions be effected in other than yearly intervals, the age cannot be determined; neither, we presume, can it be determined by admitting the yearly additions, for we are not assured when using the *deepest* magnifiers, that we see the ultimate divisions. Indeed Leeuwenhoeck himself states, that the scales of fishes are composed of an *infinitude* of layers or laminæ; an admission founded in fact, and altogether fatal to the fanciful hypothesis we have noticed. These objects require to be viewed both by transmitted and reflected light, in order that all their peculiarities of surface and structure may be satisfactorily observed.

The *crystalline lenses of fishes and other animals* exhibit a most astonishing structure under the microscope. We are indebted to Sir David Brewster for a minute and particular description of these formations, which we shall present to the reader in his own words, introducing it by two or three sentences from Mr Pritchard's *Microscopic Objects*. "If the crystalline lens in the eye of a fish, be minutely

examined by the aid of the microscope, it will be found to be composed of concentric strata or layers, somewhat resembling the coats of an onion. One of these laminæ separated, and placed under a powerful microscope, will be seen to consist of flat fibres or bands, arising from each pole of the globular lens, and expanding towards the equator, like the spaces between the meridians on the artificial globe. The edges of these fibres are serrated, and fit into each other like the teeth of a double rack, or the sutures of the human skull." "When the power," observes Sir D. Brewster, "is small, or the microscope not good, or the laminæ too thick and not nicely detached, each row of interlocking teeth appears as a dark line, sometimes as sharp as a black line drawn upon paper with a pen. Sometimes the lines appear rough and ragged, and as the fibres become less in approaching the poles, the black lines are as difficult to resolve into teeth, as the lines on test objects. The following measures will show what a wonderful structure in the eye has been disclosed to us by the microscope. The calculations refer to the lens of a cod, four-tenths of an inch in diameter.

Number of fibres in each laminæ,	2500.
Number of teeth in each fibre,	12,500.
Number of teeth in each laminæ,	31,250,000.
Number of fibres in the whole lens,	5,000,000.
Number of teeth in the lens,	62,500,000,000.

Or the lens of a cod contains five millions of fibres, and sixty two thousand five hundred millions of teeth; and if we reckon the curved end of the tooth as one surface, each tooth will have six surfaces, which come into contact with the corresponding surfaces of the adjacent tooth, so that the number of touching surfaces will be *three hundred and seventy-five thousand millions*, and yet this little sphere of tender jelly is as transparent as a drop of the purest water, and allows a beam of light to pass across these almost innumerable joints, without obstructing or reflecting a single ray." We have here given Sir D. Brewster's description verbatim; but we must enter our protest against the system of wonder-making, into which it appears even this eminent philosopher can occasionally fall. No useful end is obtained by entering into minute numerical details, of which the human mind can conjure up no idea; this practice prevailed with the early micrographers, and the consequence was, that their writings fell into neglect, and ultimately excited little attention, except from those who delighted to number the repetitions of a letter in the Bible, or to resolve the vast bulk of the ocean into separate drops of water. It is this practice, and it only, that has caused a distaste for microscopic inquiry, and exhibited it as a puerile pastime which should give place to loftier pursuits. Let all the wonders of the minute world be unveiled; but let this be done without ridiculous exaggeration or valueless precision. The microscope will never be other than a childish toy, so long as the observer's aim be rather to bewilder than to inform the popular mind. We have deemed it right to make these observations, at a time when the instrument is approaching, possibly, to its highest perfection, and when, in the words of Dr Goring, "a new and golden age of observation may be expected to commence."

The nature of the *blood, and its circulation* through the veins and arteries of animal bodies, can be thoroughly understood only by microscopic observation. "When Dr Harvey made his grand discovery of the circulation of the blood, and first lectured upon it in St Bartholomew's hospital in 1619, he was ridiculed, and lost his practice through maintaining what was then supposed to be so absurd and wild a theory. The idea was suggested to his mind by reflecting on the valves of the heart and veins, which were evidently so planned as to allow a fluid to pass but one way. All the philosophical reasoning, however, of this celebrated man, could not establish what appears to us so plain a truth, until it was evidenced in the circulation of cold-blooded animals by means of the microscope, and thus placed beyond a doubt. Discerning, as we can do, the very forms of the globules of that fluid, as they flow through the capillaries from the arteries to the veins, in obedience to the laws impressed upon them by the Almighty Creator—viewing this sublime phenomenon, by which life itself is diffused throughout, and sustained in every part of the system,—who can resist conviction of the great truth?" The same eloquent writer (Mr Pritchard,) observes in another place: "The globules of the blood may be seen passing rapidly along the capillary ends of the arteries into those of the veins, where the intervening member is sufficiently diaphanous, as in the ear of the young mouse, the fins and tail of the carp, gold-fish, stickle-back, tadpole, and of most small fish; and in the web between the toes of the frog, lizard, eft, &c. In the arachnoida, (spider tribe,) at the joints of the legs, I have observed the circulation very distinctly, the current of dark globules passing rapidly at each pulsation of the dorsal vessel. In the antennæ and wings of terrestrial insects, it has also been seen when they have just emerged from the chrysalis, as in the perla viridis and semblis bilineata. In several aquatic larvæ and small crustacea, the circulating fluid traverses the limbs, antennæ and tail, and thence moves along the dorsal vessel towards the head, and down the sides of the body, in cavities, and not distinct vessels;

hence called *diffused* circulation. The most favourable subjects for viewing this are the larva of the ephemera, larva of hydrophilus, small dysticus, &c. In several of the polypiferous zoophytes, as the tubularia indivisa, sertulariæ, campanulariæ, plumulariæ, &c. Mr Lister has, by means of the achromatic engiscope, discovered a circulation to exist, which in many respects resembles that in plants." We notice in the serum of the blood, when microscopically examined, two distinct kinds of bodies, named *globules* and *discs;* and accordingly as the one or the other preponderate in the fluid mass, the vital stream is healthy or diseased. The globules appear to be the true particles of the blood, and the discs a simple cohesion of a number of these into a circular plane; a certain proportion of these discs may probably give impulse to and assist the circulation, whilst an undue quantity may render the motion either too tardy or too violent. "Upon submitting the blood to the microscope, a remarkable fact will strike every observer, viz. there will be seen a continual motion of the globules, as if they were acted upon by some unknown agency. This motion appears completely vibratory, like a balance which has received an impulse. It is difficult to account for this phenomenon, but the following hypothesis is hazarded; this seeming tendency to motion in the globules may be a material assistance to the impulse given by the heart, whose mere mechanical force, (however great,) appears hardly sufficient to propel the globules through such inconceivably minute ramifications, through which we know it does pass, previous to reaching the organ of circulation by the large veins."

We now direct our remarks to the structure of *insects* and their transformations, from which we shall pass to a slight review of purely microscopical insects, or such as require the magnifier to develope their entire figure: these points accomplished, the present chapter must be taken as complete.

The *eggs of insects* "assume a vast variety of forms: some are furnished with covers, the surfaces of many are elegantly embossed or fluted, whilst others, as those of the bug, (cimex lectularius,) have their surface curiously granulated." "The eggs are contained and arranged in the body of the insect, in vessels which vary in number and figure in different species. It is a general rule, that eggs do not increase in size after they are laid; among insects, however, we find an exception to this; the eggs of the tenthredo of Linnæus increase after they are laid, but their shell is soft and membranaceous. The eggs of insects differ in their colours; some may be found of almost every shade, of yellow, green, brown, and even black." The eggs of the lion puceron are deposited on the leaves of the plum-tree, and several other trees, in clusters of ten or twelve. Each egg has a filament attached to it; and sometimes the egg bursts, in which state it resembles a minute flower with its stem. These flower-like forms are the shells of those eggs from which the insect has emerged. "Divine Providence instructs the insects, by a lower kind of perception, to deposit their eggs not only in safety from their numerous enemies, but also in situations where a sufficient quantity of food is on the spot, to support and nourish the larva, immediately on breaking the shell. Some deposit their eggs in the oak-leaf, producing there the red gall; others choose the leaf of the poplar, which swells into a red node or bladder. The leaves of the veronica and cerastium, are drawn into a globular head by the eggs of an insect lodged therein. In the Lapland Alps there is a fly covered with a downy hair, called the rheindeer gad-fly; it hovers all day over these animals, whose legs tremble under them. They prick up their ears, and flee to the mountains covered with ice and snow, to escape from a little hovering fly, but generally in vain, for the insect but too soon finds an opportunity to lodge its egg in the back of the deer; the worm hatched from this egg perforates the skin, and remains under it during the whole winter: in the following year it becomes a fly. The gnat, the ephemera, the libellula, and the phryganea, hover over the water all day to drop their eggs, which are hatched in the water, and continue there all the time they are in the larva state. The gnat lays but one egg at a time, which she deposits on the water in a very ingenious and simple manner; she stretches her legs out, and crosses them, thus forming an angle to receive and hold the first egg, a second egg is soon placed next the first; then a third, and so on, till the base is capable of supporting itself; these, as they come to maturity, sink deeper. The fecundity of insects exceeds in an astonishing degree that of all the productions of nature. The following is an experiment of M. Lyonet on the generation of a moth which comes from the *chenille a brosse:* out of a brood of 350 eggs, produced by a single moth of this kind, he took eighty, from which he obtained, when they were arrived at their perfect state, fifteen females; whence he deduces the following consequence: if eighty eggs give fifteen females, the whole brood of 350 would have produced sixty-five; these sixty-five, supposing them as fertile as their mother, would have produced 22,750 caterpillars, among which there would have been at least 4265 females, who would have produced for the third generation a million and a half of caterpillars. It is not surprising, therefore, that these insects should

be so numerous in years favourable to their propagation." Few insects, however, long survive their last transformation; and notwithstanding their amazing fecundity, mankind suffer comparatively small annoyance from them, in consequence of the voracity with which they prey on each other, and the avidity with which they are sought and devoured by birds and other animals. The eggs of insects are for the most part opaque objects, and admit only the examination of their outer surface; in some few instances, however, they can be viewed by transmitted light when the interior structure presents not unfrequently the most surprising and interesting phenomena.

From the egg the insect emerges into the *larva*, or caterpillar state, which exhibits a wonderful variety of structure and beauty of detail, wholly dependent upon the microscope for their satisfactory developement. This period of insect existence, with all the interesting phenomena therewith connected, will be rendered perfectly familiar by the instances we have selected for description and illustration.

"The larva of the musca chamelion lives in the water, breathes by the tail, and carries its legs within a little snout near its mouth. It appears to consist of twelve annular divisions; by these it is separated into a head, thorax, and abdomen; but as the stomach and intestines lie equally in the thorax and abdomen, it is not easy to distinguish their limits till the insect approaches the *pupa* state. The parts most worthy of notice are the tail and snout. The tail is furnished with an elegant crown or circle of hair, disposed quite round in an annular form; by means of this the tail is supported on the surface of the water, while the worm or larva is moving therein, the body in the meanwhile hanging towards the bottom; it will sometimes remain in this situation for a considerable time, without the least sensible motion. When it is disposed to sink to the bottom by means of its tail, it generally bends the hairs of that part towards each other in the middle, but much closer towards the extremity; by these means a hollow space is formed, and the bladder of air pent up in it, looks like a pearl. It is by the assistance of this bubble, or little balloon, that the insect raises itself again to the surface of the water. If this bubble escape, it can replace it from the pulmonary tubes; sometimes large quantities of air may be seen to arise in bubbles from the tail of the worm to the surface of the water, and there mix with the incumbent atmosphere. This operation may be easily seen by placing the worm in a glass full of water, where it will afford a very entertaining spectacle. The snout is divided into three parts, of which that in the middle is immovable; the two other parts grow from the sides of the former; these are movable, vibrating in a very singular manner, like the tongues of lizards and serpents. The greatest strength of the creature is fixed in these lateral parts of the snout; it is on these that it walks when it is out of the water, appearing, as it were to walk on its mouth, using it to assist motion, as a parrot does its beak, to climb, with greater advantage."

"We shall now consider the external figures of this worm, as it appears with the microscope. It is small towards the head, larger about those parts which may be considered as the thorax; it then again diminishes, converging at the abdomen, and terminates in a sharp tail, surrounded with hairs in the form of the rays of a star."

"This worm, the head and tail included, has twelve annular divisions. Its skin resembles the covering of those animals that are provided with a crustaceous habit, more than it does that of naked worms or caterpillars; it is moderately hard, and like the rough skin called shagreen, being thick set with a number of grains, evenly distributed. The substance of the skin is firm and hard, and yet very flexible. On each side of the body are nine spiracula or holes, for the purpose of respiration; there are no such holes visible on the tail ring, nor on the third ring counting from the head; for at the extremity of the tail there is an opening for the admission and expulsion of air; in the third ring the spiracula are very small, and appear only under the skin, near the place where the embryo wings of the future fly are concealed. The skin has three different shades of colour; it is adorned with oblong black furrows, with spots of a light colour, and orbicular rings, from which there generally springs a hair, as in the figure before us. Only the hair that grows on the insect's side is represented. The difference in colour in this worm arises from the quantity of grains in the same space; for in proportion as there is a greater or less quantity of these, the furrows or rings are of a deeper or paler colour. The head is divided into three parts, and covered with a skin, the grains on which are hardly discernible. The eyes are rather protuberant, and lie forwards near the snout. It has also two small horns on the fore part of the head, and a little above these the eyes are situated. The snout is crooked, and ends in a sharp point.

"The tail is constructed and planned with great skill and wisdom. The extreme verge or border, is surrounded by thirty hairs, and the sides adorned with others that are smaller; here and there the large hairs branch out into smaller ones, which may be reckoned as single hairs. These hairs are all rooted in the outer skin, which in this place is covered with rough

grains. The hairs are very seldom disposed in so regular a manner as they are represented, except when the insect floats with the body in the water, and the tail with its hairs a little lower than the surface, for they are then displayed exactly as delineated in the cut annexed. The tail serves the larva both for the purposes of swimming and breathing, and it receives through the tail that which is the universal principle of life and motion in animals. By means of the hairs it can stop itself at pleasure when swimming, or remain suspended quietly in the water for any length of time. The motion of the insect in swimming is very beautiful, especially when it advances with its whole body floating on the surface of the water; after filling itself with air by the tail. To set out, it first bends the body to the right or left, and then contracts in the form of the letter S, and again stretches it out in a straight line: by thus alternately contracting and extending the body, it moves along on the surface of the water. These larvæ are generally to be found in shallow standing waters, about the beginning of June."



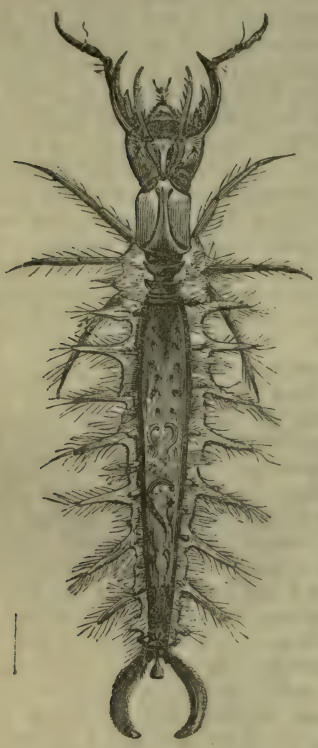
We are permitted by Mr Pritchard to copy from the new edition of his *Microscopic Illustrations* (p. 70 et seq.) the following description and illustration of the larva of a British Hydrophilus (*Hydrophilus caraboides.*)

"In examining the peculiarities of the structure and habits of this larva, what most strikingly attracts our attention is its ferocious and savage disposition, and the fitness of its organs for the exercise of its ravenous propensities. It may be safely asserted that no species of larvæ is known to be provided with weapons of destruction so powerful, so numerous, and so well adapted to their end, as those which this creature possesses. It is on this account that it has been properly called the *Water Devil.* Its size is but little inferior to that of the larvæ of any of the British coleoptera, as it measures, when arrived at maturity, an inch and a half in length, while the superior strength and courage manifested in its attacks on small fish, and other animals larger than itself, is truly surprising.

"About the latter end of April, and during the month of May, small nests of these insects are often found floating among weeds and water plants, in stagnant pools, and are frequently taken in the nets of those who are searching for the early kinds of larva. They are in the form of balls, of a dusky white colour, and a silky texture, and have each a small stem of the same nature as the nest, but more dense. By means of this filament they are attached to the roots or stalks of weeds at the bottom of the water. In this situation they remain during the winter, and are thus effectually preserved from the effects of intense cold. Early in the spring, the stem or cable to which we have referred is detached from the weeds, by the winds which at that time prevail, and the nest rises to the surface of the water, and there floating, receives the genial influence of the sun. These nests may be taken and placed in a basin of water, and, as the season advances, hatched by the heat of the sun. On the larva leaving the nest, which it accomplishes by gnawing a hole in the side, the infant immediately descends to the bottom of the vessel, with its jaws extended in search of prey, and eagerly devours all the small aquatic insects that are within its reach; if however, there is a scarcity of food in the immediate neighbourhood of the nest, they may be seen to attack and devour each other."

"These larvæ, as well as most of those of the larger kind, are found at a greater depth of water than are the smaller ones; although, in their pursuit of small prey, they may occasionally be taken in shallow places. In its infant state, this larva is very transparent; hence its internal structure may be clearly distinguished. When about a quarter of an inch in length, it swims very nimbly. The colour of the head is a strong Indian yellow, with darker shadings of a bright chestnut; the eyes are now bright carmine. It is more sparingly covered with hairs, and its swimming appendages are shorter than at a more advanced period; and the head is larger, in proportion to the size of the body, than when the creature has arrived at maturity. In this respect it resembles many other creatures in its mode of growth, the head seeming to be developed and perfected before the rest of the system."

"The manner in which this larva treats its prey evinces an extraordinary degree of instinct. Many of the creatures on which it feeds are crustaceous about the head and back; hence they are most vulnerable at the under part of the body. This part, therefore, the larva attacks; and, to accomplish its aim, swims underneath the intended victim, and bending back its head, is enabled thus to reach its prey by means of its jointed antennæ. (The illustrative figure represents a magnified view of the larva taken while young.) Its next



operation is to pierce its prey with the curved mandibles. Having thus secured its object, it immediately ascends to the top of the water, and, holding it above the surface, so as to prevent its struggling, shakes it as a dog would a rat. It next inserts the piercer and sucker, (between the mandibles) which are capable of being thrust out or withdrawn at pleasure. When the juices of the victim are not easily procured by suction or exhaustion, the serrated forceps are employed to tear and masticate it, and thus cause the juices to be more easily obtained. If its food be plentiful, this larva arrives at its full growth in the course of three or four months, and is then nearly opaque and covered with hair. It can be kept several days without food, and by this exinanition its structure becomes considerably more transparent; while its natural ferocity is greatly increased, so that it will attack and fight with creatures much larger than itself, and even with its own species. It may be remarked, that it studiously avoids any contest with the *nepa*, or water scorpion."

"On a fine sunny day the larvæ rise to the surface of the water, and delight to bask in the sun; but if watched they remain motionless, with their claws extended. If a stick, or any other substance, be presented to them, they will immediately seize it, and will sometimes suffer themselves to be cut into pieces before they relinquish their hold. Their bite has been considered poisonous by many persons, as it takes a greater length of time to heal than other wounds of the same extent: so that caution should be used in taking them. Touching the anatomy of this creature, it may be observed, that the sucker is contained in a crustaceous sheath, and may be considerably protruded or completely withdrawn at the pleasure of the larva: in the annexed cut it is shown extended to about three quarters of its length. The eyes are compound, but of a peculiar formation, consisting of seven oval apertures ranged like leaves upon a branch. The whole of the head and thorax are curiously marked with a number of lines and spots. The legs are six in number; they are thickly set with rows of hair on their opposite sides, and each is furnished with a sharp claw. The number of swimmers on each side is seven; they are covered with hairs, and to the specimen from which the drawing was taken, a vast number of *vorticellæ convellariæ*, or bell-polypi, were attached. These will be recognized in a subsequent engraving by their bell-shaped figure. They sometimes infest this species of larvæ to such a degree as considerably to impede its motion in swimming. On each side of the abdomen, which commences near the origin of the first pair of swimmers, arise the great tracheæ, or air-vessels, distinguished in the cut by a deeper shade than the other parts; the two approach each other near the tail, where an exceedingly curious process is also distinctly exhibited. The whole surface of the body is thickly covered with hairs, and several tufts are disposed in clusters with some regularity, down the back and sides. The flexible pulsatory organ, or dorsal vessel, situated at the lower part of the body, is in perpetual motion. Its form somewhat resembles the letter S inverted: it however varies a little during its vibrating motions. The use of the curious appendages at the lower extremity of the body is unknown. Its tail is bi-forked and crustaceous, and is marked as shown in the cut. The short line shows the natural size of the larva, at the same period of its growth as that at

which the magnified drawing was made. As it approaches maturity, it casts its skin several times, from each of which it escapes by a rent formed down the back."

"In this larva the air is supplied for respiration by proper orifices situated at the tail; and the creature is obliged to ascend to the surface of the water, and elevate its tail out of it, at every inspiration. When the air thus inhaled has become unfit for inspiration, it is expelled at the same orifice, and a small bubble may frequently be seen issuing from the tail, and ascending in the water. On a careful examination of the skin, which by the bye affords an excellent object for the microscope, there will not appear any spiraculæ along the sides, as in perfect insects."

We have been compelled to abridge Mr Pritchard's description from want of space, and we have likewise made a few necessary verbal alterations to connect it with our wood engraving: in the *Microscopic Illustrations*, the figure is exhibited in a most elaborately executed coloured plate.

The preceding instance has shown us the voracious and fierce propensities of insects in the larva state; we now reverse the picture, and discover the sufferings and inconveniences to which they are themselves exposed. The following are the curious observations of an ingenious naturalist. "As I was observing," says he, "one day some caterpillars which were feeding voluptuously on a cabbage leaf, my attention was attracted to a part of the plant, about which a small ichneumon fly was buzzing on its wing, as if deliberating where to settle: I was surprised to see the herd of caterpillars, creatures of twenty times its size, endeavouring, in an uncouth manner, by various contortions of the body, to get out of its way, and more so whenever the fly poised on the wing as if going to drop; at length the creature made its choice, and seated itself on the back of one of the largest and fairest of the cluster: it was in vain the unhappy larva endeavoured to dislodge the enemy. If the caterpillar had shown terror on the approach of the fly, its anguish at intervals now seemed intolerable, and I soon found that it was in consequence of the strokes or wounds given by the fly. At every wound the poor caterpillar wreathed and twisted its whole frame, endeavouring to disengage itself, by shaking off the enemy, sometimes aiming its mouth towards the place; but it was all in vain, its little, but cruel, tormentor kept its place. When it had inflicted thirty or forty of these wounds, it took its flight with a visible triumph; in each of these wounds the fly had deposited an egg. I took the caterpillar home with me to observe the progress of the eggs which were thus placed in its body, taking care to give it a fresh supply of leaves from time to time, it recovered to all appearance in a few hours from the wounds it had received, and from that time, for the space of four or five days, seemed to feed with its usual avidity. The eggs were all hatched into small oblong voracious worms, which fed from the moment of their appearance on the flesh of the caterpillar, in whose body they were inclosed, and seemingly without wounding the organs of respiration or digestion; and when they had arrived at their full growth, they ate their way out of the sides of the larva, at the same time destroying it. The caterpillar thus attacked by the larvæ of the ichneumon fly never escapes, its destruction is infallible; but then its life is not taken away at once; the larva, while it is feeding thereon, knows how to spare the parts which are essential to its life, because its own is at that time tied up in that of the caterpillar. No butterfly is produced from the caterpillar; the worms that feed on the wretched creature, are no sooner out of its body, than every one spins its own web, and under this they pass the state of rest necessary to introduce them to their winged form."

We conclude our notices of larvæ with an extract from Burt's "Observations on the Curiosities of Nature," which appeared in Chambers' Edinburgh Journal. The details here offered are very similar to those just given; there are, however, several new and interesting facts connected with the present instance, which justify the partial repetition.

"The capada worm, or insect-fly carrier, is produced, like the silk-worm, from the eggs which its mother scatters every where, after she has undergone her metamorphosis into a white butterfly. It begins to live at the end of July, and at its birth is arrayed in a robe of the most brilliant and variegated colours. When on the point of undergoing its metamorphosis in August, it throws off this superb livery, and puts on another of an admirable sea-green hue. This fundamental colour reflects all its various shades, according to the different undulations of the animal, and the different accidents of light; but this new decoration announces the approach of a period when it is doomed to undergo great tortures. It is immediately assailed by a swarm of ichneumon flies, one of which inserts itself into each of the pores of its body, not an opening being left unoccupied. All its struggles to get free of its tormentors are in vain. These flies, which are so small they can only be studied by the microscope, drive their sting into the skin of their victim, over the wild extent of its back and sides. Afterwards all at the same moment, they slip the eggs they have into the bottom of the wounds which

inflicted. No sooner is this operation performed, than the ichneumon flies disappear, and the patient remains for an hour in a drowsy and even motionless state, out of which it awakens to feed with its former voracity. It then appears much larger, and its size increases every day. Its green colour assumes a deeper hue, and the tints produced by the reflection of the light are more strongly marked. About a fortnight after the worm has been encumbered with this factitious pregnancy, the prospect of a numerous progeny begins to be apparent. By the aid of a microscope the eggs may be seen hatching in the body of the animal; and as they are all produced at the same instant, a single glance reveals the capada worm covered with a living robe of (larvæ of) ichneumon flies. They issue from every pore, all the body being covered with them, only the top of the head appearing bare. Its colour then changes to dirty white, and the little worms assume a black appearance to the eye, although their true colour is a deep brown. This operation lasts about an hour, and it is followed by another, which is not much more protracted, but still more singular. Immediately that the ichneumon worms are hatched, without quitting the spot where they separate themselves from the eggs, they yield a liquid gum, which becomes solid on exposure to the air. At the same time, and by a simultaneous motion, they elevate themselves on their lower extremities, shake their heads and one half of their bodies, and swing themselves in every direction. And now they commence a very curious operation. Each of these animalcules works himself a small and almost imperceptible cocoon in the shape of an egg, in which he wraps himself up. The formation of these cocoons occupies only about two hours, and myriads of them being crowded close together, form a white robe, with which the capada worm appears elegantly and comfortably clothed; but while they are thus busily arraying him in his new attire, he remains apparently unconscious of their assiduities; he is then in a state of insect paralysis. As soon as this covering has been completed, and the little artists who wove it have retired to their cells, the worm endeavours to rid himself of his officious guests, and of the robe which contains them, but he does not succeed in the attempt without the greatest efforts. At length he contrives to get rid of the encumbrance; but instead of his former fat and shining appearance, he presents all the decrepitude of extreme old age. He is flaccid and dull; his skin is wrinkled and dirty; and, in short, symptoms of approaching dissolution begin to display themselves. He still makes a desperate effort to gnaw a few leaves, but he no longer devours them with that voracity which indicates a vigorous constitution. Shortly afterwards he passes into the state of a chrysalis, and in giving life to thousands of eggs, he relinquishes his own."

The *pupa* state of insects is the intermediate stage between the larva and the perfect developement, and affords many opportunities to the microscopical observer for detecting curious and interesting formations and phenomena.

"When the larva has attained to its full growth and the parts of the future insect are sufficiently formed beneath its skin, it prepares for its change into the pupa state; it seeks for a proper place in which to perform the important business. The different methods employed by these little animals to secure this state of rest, may be reduced to four: 1. Some spin webs or cones, in which they inclose themselves. 2. Others conceal themselves in little cells, which they form under ground. 3. Some suspend themselves by their posterior extremity; 4. While others are suspended by a girdle that goes round their body. In proportion as the change into the pupa form approaches, the body is observed often to extend and contract itself; the hinder part is that which is first disengaged from the larva skin; when this part of the body is free, the animal contracts and draws it up towards the head; it then liberates itself in the same manner from the two succeeding rings, consequently the insect is now lodged in the fore part of its larva covering: the half which is abandoned remains flaccid and empty, while the fore part is swollen and distended. The animal, by strong efforts, still forcing itself against the fore part of the skin, bursts the skull into three pieces, and forms a longitudinal opening in the three first rings of the body; through this it proceeds drawing one part after the other, by alternately lengthening and shortening, swelling and contracting the body and different rings; or else, by pushing back the exuvia, gets rid of its odious reptile form. The larva, thus stripped from its skin, is what we call the pupa, chrysalis, or aurelia, in which the parts of the future insect are inclosed in a crustaceous covering, but are so soft, that the slightest touch will discompose them. The exterior part of the chrysalis is, at first, exceedingly tender, soft, and partly transparent, being covered with a viscous fluid; this soon dries up, thickens, and forms a new covering for the animal, capable of resisting external injuries; a case, which is at the same time the sepulchre of the larva, and the cradle of the insect; where, as under a veil, this wonderful transformation is carried on. The chrysalis of the common white butterfly furnishes a most beautiful object for the microscope. Those who are desirous to examine the various members of the insect in its pupa state, should

examine it before the forementioned fluid is dried up, when it will be found to be the perfect insect with the members glued together; these, by degrees, acquire sufficient force to break their covering, and disengage themselves from the bands which confine them. While in this state, all the parts of the insect may be traced out, though so folded and laid together, that it cannot make use of them; nor is it expedient that it should, as they merely pass through this state to be hardened and strengthened."

The exuviæ or cast skins, of insects, in their larva, pupa, or perfect state, form most interesting microscopic objects. "We find in the exuviæ of the caterpillar, the skull, the jaws, and all the exterior parts, both scaly and membranaceous, which compose its upper and under lip, its antennæ, palpi, and even those crustaceous pieces within the head, which serve as a fixed basis to a number of muscles; we further find the spiracula, the claws, and sheaths of the interior limbs, and in general all that is visible of the caterpillar." From an attentive examination of the various exuviæ which are cast off by insects in different stages of their existence, we are led to consider them a compound system of organized bodies, contained one within another; for we not only find in the cast skins all the exterior characters of the insect, but even the coats of the gullet, pulmonary tubes, tracheal vessels, &c. Indeed, there is not in animated nature a more incomprehensible phenomenon than the faculty which insects possess of throwing off, *repeatedly*, the first surface of their exterior members and internal organs. The writer was walking, some years since, on a warm summer evening, along the banks of a river in the south of England, when a number of small *ephemeræ* settled on his dress; he paid particular attention to one that had alighted on his arm, and witnessed, in the course of a quarter of an hour, no fewer than five exuviæ thrown off by the insect. These moultings, as they may be termed, appeared to be effected with much effort and suffering: the body of the insect swelled, and deepened in colour, and seemed to be exerting great muscular energy to detach the exuviæ. Another change of colour to dusky white, indicated the moment when the skin was about to be cast off; the insect appeared to emerge from it easily; and for an instant the rejected covering presented a perfect skeleton, but immediately afterwards collapsed and shrivelled up. What is very remarkable, the insect suffered no apparent diminution of bulk from these repeated skinnings, and at length flew off and joined the countless swarm that hovered about the water, into which, after a very brief interval, they would fall lifeless

The *imago*, or fly state of insects, is the ultimate development of their forms, and usually exhibits structures which for beauty and delicacy are the very antipodes of the larvæ whence they are derived. For instance, the unsightly caterpillar, crawling painfully from leaf to leaf, or gorging itself with gross nutriment, is transformed into the butterfly, that skims lightly over the earth, or mounts with sylph-like wing into the very clouds; which feeds daintily, and sips only the purest nectar of the opening flowers. It was a most happy thought of the early times to make the butterfly an emblem of immortality; it was, however, reserved for latter ages to discover all the pertinence and value of the type. By the aid of the microscope we have ascertained, that not only the ravenous jaws and the whole exterior parts of the larva are thrown off, even to the eyes themselves, but that the internal system, the stomach, lungs and various organs, are all exchanged for other organs, members, and faculties, suited to that higher state of existence to which the insect form is summoned. Surely we may, with no irreverent fancy, admire this lively emblem of the corruptible putting on incorruption, and the mortal putting on immortality.

We proceed to notice the wonderful structure observable in the different parts and members of insects.

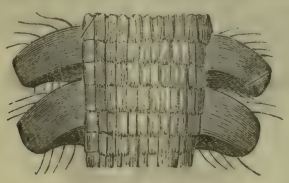
The *antennæ* and *palpi* are fine slender articulated horns, movable in nearly all directions, and constituting one of the distinguishing characteristics of the insect tribes. The antennæ are beautiful and various in form, of a delicate structure, and so minutely jointed as to be instantaneously movable at the pleasure of the insect. They are situated on the fore part of the head. The articulations differ in shape, length and number, and vary greatly in different species; the antennæ of the male differ also from those of the female. The greater number of insects have only two antennæ, but some few have four. Regular rows of minute holes are said to have been discovered in the antennæ. Several insects cover their eyes with them whilst they sleep. Many conjectures have been formed regarding the use of these appendages: some have considered them organs of smelling and hearing, others have supposed them to be appropriated to a delicate species of feeling. From the use to which the creature applies them, we are perhaps justified in considering them the organs of touch and hearing. If any sudden noise be made close by an insect provided with antennæ, the motion of these horns sufficiently indicates that they are affected by the vibrations of the air; and, indeed, it is rational to suppose that their delicate structure and articulations must convey a sensation of sound

to the insect. That an acute sense of touch resides in the antennæ, cannot be doubted by any one who has noticed how carefully insects pilot their way with them, and that they never, except when flying, pass from one twig or leaf to another without first testing its security with their horns.

The annexed cut represents one of the antennæ of the *Bombyx antiqua*, highly magnified.



In the following figure, a portion of the antennæ is seen vertically, covered with an imbrication of white scales or feathers, under which the *pectens* issue on each side.



The head of the Bombyx caja, exhibiting one antennæ, and the insertion of the other, is represented by the following figure.



The palpi are small filiform articulated horns, from four to six in number, placed near the mouths of insects. These are usually termed the *feelers*, as the creature is observed to thrust them in every matter, as a hog would its nose, when in search of food. Some have supposed them to be a provision by which the insect is enabled to hold its food near the mouth.

The *eyes of insects* are a wonderful piece of mechanism, differing considerably in their construction from those of other animals. "Among the exterior parts of insects, none are more worthy of minute investigation, and very few persons can be found who are insensible to the beauties of this organ when exhibited under the microscope, which instrument alone can point out to us the prodigious art employed in its organization." The eyes of insects differ in different species; they vary also in number, situation, connection, and figure. "In other creatures they are moveable, and two in number; in insects, the genus *cancri* excepted, they are fixed; they have no eyebrows or eyelids, but the outer coating is hard and transparent. The greater part of insects have two eyes; some have a larger number varying from three to eight. The eyes of insects are of two kinds: the *stemmata*, or single eyes; and the *reticulated*, or clustered eyes." The stemmata were first noticed by M. de la Hire; they are three lucid protuberances placed on the back part of the head of many insects: their surface is glossy, of an hemispheric figure, and a coal black colour. Reaumur made experiments on these eyes, and found that when they were covered the insects flew to a small distance only, and apparently at random; the reticulated eyes appear to be adapted only for long vision, and do not give distinct images of objects close at hand. The reticulated eyes are wonderful structures when examined by the microscope: they are those hemispherical protuberances on the sides of the insect's head, which in the mass are obvious to the unassisted eye, and are even seen, without optical assistance, to be composed of a kind of net work. Each protuberance, in its natural state, is a body cut into a number of faces, like an artificial multiplying glass; but with this superiority in the workmanship, that as there, every face is a *plane*, here, every one is *convex*, immensely more numerous, and contained in a much smaller space. If one of these protuberances be taken from the head of the insect, washed clean, and placed before the microscope, its whole structure is seen, and it becomes an object worthy of the highest admiration. Each separate eye is found to have an hexagonal, a quadrangular, or other regular sided figure, varying in size according to its situation in the head, and including a convex, or in point of fact, a meniscus lens, composed of a number of layers, which may be separated by maceration, and subjected to special examination.

"The eyes of the libellula, or dragon-fly, on account of their size, are peculiarly adapted for microscopical examination; and by the assistance of the instrument, you will find that

they are divided into a number of hexagonal cells, each of which forms a complete eye. The external parts of these eyes are so perfectly smooth, and so well polished, that, when viewed as opaque objects, they will, like so many mirrors, reflect the images of all the surrounding objects. The figure of a candle may be seen on their surface multiplied almost to infinity, shifting its beam to each eye, according to the motion given to it by the hands of the observer. Other creatures are obliged to turn their eyes towards the object, but insects have eyes directed thereto, on whatsoever side it may appear: they more than realize the wonderful accounts of fabulous history: poets gave to Argus an hundred eyes; insects are furnished with thousands, having the benefit of vision on every side with the utmost ease and speed, though without any motion of the eye or flexion of the neck."

The reticulated eyes in some of the fly class are not inferior in appearance to the richest gems: they exhibit nearly every variety of colour under a brilliant and surpassing lustre. In connection with the general description, we have only to add that the number of separate lenses in the hemispherical reticulations of some insects are almost beyond belief: the agrion has no fewer than 12,000 distinct lenses, or separate eyes, the common house fly 8,000, the hawk moth 20,000, the libellula 12,544, the melolontha 8,820, the mordella 25,088, papilio 17,008, phælana cossus 11,300, the scarabæus 3,180. We in vain attempt to reason regarding these lucid points, each of which is a meniscus lens of several layers, connected with a pyramid of fibres and pulmonary tubes whose uses we cannot determine.

The *tongue* or *proboscis* of insects is a taper and compact instrument, by which they obtain the juices of plants or other nutriment requisite for them. Some creatures can contract or expand it, others roll it up with dexterity; in some it is inclosed within a sheath. It is taper and spiral in the butterfly, tubular and fleshy in the fly; in all affording agreeable amusement for the microscope.

The following represents the tongue of the



papioli urticæ taken out and unrolled, displaying two segments, as united with the *rugæ* of which they are composed, and the papillæ or absorbents towards the end.

The following figure on the left hand gives a front view of the mouth without the palpi, the clipeus being raised to show the opening of the mouth and insertion of the tongue.



The right hand figure shows the manner in which the tongue, after the extremity has been applied to the nectary of a flower and has absorbed the juices, is conveyed to the mouth, and the papillæ cleansed by scraping on the under part of it.



Above is represented the under part of the mouth and tongue, with the articulations of the palpi.

"The bee's tongue, for its complex yet finished structure, and the trunk of the common house-fly, with the spiral fibres of the muscles which surround its termination, will amply repay the pains of an attentive and minute examination." These two objects form the principal subjects of our illustrations on this head; and the brief descriptions we are enabled to give of them, will convey a general idea of the wonderful structure and admirable adaptation of parts by which these insect organs are distinguished.

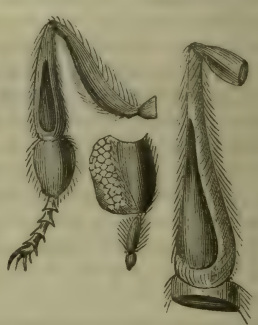
Plate 34, fig. 32, exhibits the tongue or trunk of the common house-fly, as it appears under a considerable magnifying power. This is one of the most interesting and beautiful objects that can be submitted to the microscope, especially when it is mounted in Canada balsam and viewed by transmitted light. Baker thus describes it:—"It consists of two parts folding over one another and sheathed in the mouth. The extremity thereof is sharp like a knife, for the separation of any thing. The two parts can also be formed, occasionally, into a pair of lips for taking up proper quantities of food, and by the fly's sucking in the air, they become a kind of pump to draw up the juices of fruits or other liquors." We call particular attention to the serrations of the tongue; these are separate and perfect teeth,

as may readily be ascertained on examination with a moderate magnifier of good defining power.

Plate 35, fig. 43, represents the trunk of the honey-bee, magnified in the same degree as the preceding object. Swammerdam and Reaumur have described this subject at great length; but as the instruments they used were very deficient in defining power, they were led into hypothetic statements not altogether agreeing with facts more recently ascertained. Their drawings of this insect member are very wide of the truth. Our illustration was copied from a specimen finely prepared in balsam; and it offers the best resemblance to the object of any that has hitherto appeared, taking into consideration the limited scale on which it is drawn, which does not admit of extensive detail. The reader will at once notice the similarity between the trunk of the bee and that of the elephant; their mechanism appear, indeed, to be identical so far as it is intended to facilitate the curvature, contraction, and extension of the member. The trunk of the bee is, however, peculiar in its termination, and seems to be so constructed that the insect may fix it, in the manner of a leech, within the nectarium of the flower, and, by alternately contracting and extending the organ, pump or suck up the juices of the blossom. The surface of the member is marked with a number of parallel rings, and covered with a fine hair. The two bodies, one on each side, are a pair of the palpi.

The *legs and feet* of insects exhibit most curious and elegant structures, worthy of minute examination by all who take interest in the adaptation of animal members and the mechanical powers which they respectively possess. From a microscopic consideration of the limbs of insects, we ascertain that muscular energy increases as the size of the animal decreases. "The motions of animals are proportioned to their weight and structure; a flea can leap to the distance of at least two hundred times its own length; were an elephant, a camel, or a horse to leap in the same proportion, their weight would crush them to atoms. The softness of their texture, and the comparative smallness of their specific gravity, enable insects to fall without injury from heights that would prove fatal to large animals." The legs of insects are named and classed according to the motions for which they appear to be principally adapted. "Thus some are named *cursorii*, from their adaptation for running; these are the most numerous. The *saltatorii* are those that are used for leaping; the thighs of these are remarkably large, by which means they possess considerable strength and power to leap to great distances. The *natatorii* are those that serve as oars for swimming; the feet of these are flat and edged with hairs, possessing a proper surface to strike against the water, as in the *dytiscus*, notonecta, &c. Such feet as have no claws are termed *nutici*. The *chelæ*, or claws, are an enlargement of the extremity of the fore-feet, each of which is furnished with two smaller claws, which act like a thumb and finger, as in the crab. The under part of the feet in some insects is covered with a kind of brush or sponge, by which they are enabled to walk with ease, on the most polished substances, and in situations from which it would seem they must necessarily fall." We give an illustration of this class of objects in plate 34, fig. 24, which exhibits, under a low magnified power, the leg and foot of that voracious aquatic fly, the dytiscus. We have referred principally to the strong claws, or talons, with which it is armed: a more interesting feature in this object is the web that surrounds the foot, this however, from its exceedingly complicate structure, could not have been effectively shown on a small scale.

This cut represents the legs of a bee as developed by a moderate magnifying power.



The *wings and wing cases* (*elytra*) of insects form an exceedingly numerous and a highly interesting class of microscopic objects. "The variety in the form and structure of these insect appendages is almost infinite; the beauty of their colouring, the art with which they are connected to the body, the curious manner in which some are folded up, the finer articulations provided for this purpose, by which they are laid up in their cases when out of use, and yet are ready to be extended in a moment for flight; together with the various ramifications, by which the nourishing juices are circulated, and the wings strengthened, afford a fund of rational investigation highly entertaining; exhibiting, particularly when examined by the microscope, a most wonderful display of divine wisdom and power. The more delicate and transparent wings are covered and protected by *elytra*, or cases, which are generally hard and

opaque. "The wings of moths and butterflies are mostly farinaceous, covered with a fine dust; by the assistance of the microscope, we discover that this dust is a regular assemblage of organized scales. Under the wings of most insects which have only two, there is a small head placed on a stalk, frequently under a little arched scale; these are called *halteres*, or *poisers*; they appear to be rudiments of their hinder wings," or substitutes for them: "it has been supposed that they serve to keep the body in equilibrio when the insect is flying. The elytra, or exterior wing cases, are harder and more opaque than the wings under them; they are generally highly polished, and often enriched with various colours, adorned with ornamental flutings, and studded with brilliants, whose beauties are beyond description. All these ornaments are united in the wing case of the *curculio imperialis*, or diamond beetle, one of the richest and most magnificent creatures in nature. It is said, that in the Brazils, whence they come, it is almost impossible to look at them on a sunny day, when they are flying in little swarms, so great is the glowing splendour of their heightened colours."

Our illustrations of wings will be found in plate 34, figs. 22, 23, and 25. To have given with full effect the remarkable details in these members, they must necessarily have been drawn upon a large scale, and by consequence have limited the variety of our objects. The reader must, therefore, consider these figures as little more than an indication of the wondrous beauty and delicacy observable in these objects when subjected to deep magnifying powers.

Fig. 22. *The wing of a gnat.* This object is remarkable for the delicate *punctæ*, or dots, that cover the entire membrane, and from each of which an exceedingly fine spine, or point, juts out. The fibres of the wing are serrated, or, more properly, armed with thorny projections, similar in character to fig. 9. The outer margin is thickly set with a vast number of small scales, or feathers, much resembling those on the wings of butterflies. The low power under which we have exhibited this object is not sufficient to develope the true character of the minute details.

Fig. 23. *The wing of an ichneumon fly.* This object is shown under the same power as the preceding; and it will be seen that the dots on the membrane, and the spine of each dot, are much less delicate in this wing than in that of the gnat. The upper margin is serrated.

Fig. 25. *The wing of an earwig.* "Though the earwig is so common an insect, yet few people know that it has wings, and fewer yet have seen them; they are of a curious and elegant texture, and wonderful structure. The upper part is crustaceous and opaque, while the other part is beautifully transparent. They fold up into a very small compass, and lie neatly concealed under the elytra, which are not more than a sixth part of the wing in size. The insect shuts up the ribs like a fan; the strong muscles used for this purpose are seen at the upper part of the figure. The ribs are extended from the centre to the outer edge, others are extended only from the edge about half way; but they are all united by a band at a small but equal distance from the edge; the whole evidently contrived to strengthen the wing, and facilitate the various motions thereof; so that in these wings you find all the motions that are in the most elaborate and portable umbrellas, executed with a neatness and elegance surpassing description."

"The wings of butterflies are covered with a fine dust which renders them opaque, and produces those beautiful and variegated colours by which they are so richly adorned, and so profusely decked. If this be wiped off, you find the remaining part, or naked wing, to consist of a number of ribs, like those in the leaves of plants, but of a crustaceous or talcy nature; the largest rib runs along and fortifies the exterior edge of the wing; the interior edge is strengthened by a smaller vessel or rib. The ribs are all hollow, by which means the wing, though comparatively large, is very light. The substance between the ribs, which constitutes the body of the wing, resembles talc, and is surprisingly thin and transparent; as this is extremely tender, one use of the scales may be to protect it from injuries. When the fly emerges from the chrysalis, the wings are soft and thick, and if they be examined in that state, will be found to consist of two membranes that may be raised up and separated, by blowing between them with a small tube: the ribs lie between these membranes. Ever since the microscope was invented, the dust that covers these wings has engaged the attention of microscopic observers; as by this instrument it is found to be a regular collection of organized scales of various shapes, in whose construction there is as much symmetry, as there is beauty in their colours. Their shapes are not only very different in butterflies and moths of various species, but those on the same moth or fly are also found to differ. Of the scales, some are so long and slender that they resemble hairs, except that they are a little flattened and divided at the ends, some are short and broad; some are notched at the edges, others smooth; some are nearly oval, while others are triangular: they are mostly furnished with a short stalk or stem to fix them to the wing." The prodigious number of small scales which cover the wings of papillæ, and their regular arrangement,

covering one another like the tiling of a house, are interesting facts ascertained by microscopic observation.

Many of the improvements recently introduced into the elements of the microscope, are the results of elaborate inquiries respecting the scales on the wings of butterflies, whence the latter have come to be denominated *test* objects, as being peculiarly fitted to test or prove the defining and penetrating power of the best instruments. The information in consequence derived concerning these delicate formations, may be regarded by some as more curious than useful; it is at least *curious*, and we believe few persons will deem it beneath the dignity of science to investigate the minutest atom, since it could be produced only by the same plastic energy that evoked the universe into being. Dr Goring has the merit of being the first to examine into all the details of these objects, which he has developed with much success, though principally with a view to suggest those important improvements in the microscope, which have since been reduced to practice by his talented coadjutor, Mr Pritchard, who by his various writings and optical constructions, has at once stamped himself a philosopher, and if not the first, one of the first practical opticians of the day.

Leeuwenhoeck remarks, when speaking of the scales on the wings of butterflies,—"that if an hundred, or more, of them were to be seen lying together, each would appear of a different shape." Now, though this observation is strictly true, inasmuch as there is the same variety exhibited in the formation of these atoms as in that of the human countenance, still this is not the grand point of admiration: the most wonderful fact connected with them is, that amidst all the variety of individuals, we no more mistake the different species of these scales, than we do the various species of the human race, in consequence of the great variety of features observable in them. Since these objects have been subjected to severe examination, questions have arisen regarding the real nature of their structure, which have perhaps been disputed beyond the point of usefulness. In describing the varieties which are offered in our illustrations, we shall take occasion to remark upon the various opinions that are entertained respecting the striated markings on these scales. It may be necessary to inform the general reader that these minute atoms form that impalpable powder on the wing of a butterfly, which clings to the finger whenever we touch the insect.

We proceed to describe in order figs. 10 to 21 inclusive, in plate 34. The objects are all shown under a superficial magnifying power of 90,000. Fig 10. *Scale of the red under-wing butterfly.*—This is an exceedingly beautiful formation, under a deep power of the microscope. The longitudinal and cross *striæ* (or markings) are easily developed by a good defining power. The cross lines give to the others the appearance of strings of beads. It is asserted that this *apparent* structure in the object under review, and in others of this class, is really the interlocking of the serrated edges of the fibres composing the scale. The opinion is founded on a presumed analogy between these formations and the laminæ in the crystalline lenses of fishes, &c. We are, however, inclined to dispute this opinion, since there is no general resemblance between the structures to justify the argument from analogy in this case; and moreover, a less overstrained analogy may be inferred between different objects of this class, some of which present their details to view, under a powerful magnifier in a manner that dispels all doubt as to their real nature. Of these we shall speak in order; simply observing in this place, that from an attentive examination of various scales, and their probable similarity of structure, we are led to think that, in the formation before us, the longitudinal striæ are fibres, produced on the same principle as the hairs of animals, and consist of a number of minute cups growing out of each other; and that the cross striæ are merely indications of the several insertions. The fibres are connected by a delicate tissue.

Figs. 11, 12, and 13. *Scales of the brassica butterfly.* These are three varieties of scales from the wings of the brassica, or cabbage butterfly. Fig. 11. resembles the object previously described, excepting that there is a marked and decisive difference between the contour of the two scales. Fig. 13. is termed the Brassica *curiosa;* and is no less remarkable for its exterior form, than for the singular disposition of the striæ on its surface. Fig. 13. is a scale from the *pieris brassica*, and we shall connect our remarks upon this object with fig. 17, the scale of the *podura plumbea*, as these two delicate formations are the severest *tests* of microscopic definition and penetration, and the examination of them has led to a lengthened controversy regarding the true character of the lines that cover them. In our illustrations, the delicate longitudinal striæ only are shown; but under a suitable power, and with a due management of the light, these objects exhibit diagonal lines whose real nature, owing to their extreme fineness, can merely be inferred from assumed analogies. The scales of the *lepisma saccharina* offer their details to the eye in a very satisfactory manner, under a linear power of 200 or 300; and we are convinced that they afford the best explanation that can be obtained regarding the podura and brassica. The lepisma distinctly shows a series of

strong longitudinal fibres, from whose sides proceed a number of spines much resembling those in fig. 4. These spines form, we believe, the diagonal lines in other and more delicate scales, such as the podura; for by varying the illumination and moving the object, we can discover in the lepisma all the appearances which perplex the observer when examining the podura and brassica. And, indeed, it is a fair inference that these minute scales have great similarity of structure, and that those most easily developed may justly be taken as an index to others more difficult of examination, when, as in the present case, there is nothing to contradict the analogy. Mr Pritchard seems to hold opinion with us; for he remarks, in his *List of Microscopic Objects*, "In my best engiscopes, under certain illuminations, the markings (of the podura) appear *detached*, like short hairs or *spines* covering the delicate tissue of the scales." The high authority of Sir David Brewster is, however, opposed to our explanation of the phenomena of the *tests;* and we deem it proper to give his theory as a necessary check upon our own.

"After a laborious examination of the lined tests, and the use of every optical resource which he could command, Sir David Brewster has found that the mysterious lines on these test objects are only apparent lines, being composed of a succession of interlocking teeth, by which the fibres to which they are attached form that delicate film that composes the scale of a moth." This is Sir David Brewster's opinion regarding the *longitudinal* striæ; and is the result of his examinations into the structure of the crystalline lenses of fishes. "With regard to the diagonal or oblique lines," it is added, "which have been such a source of perplexity to microscopical observers, we have little hesitation in pronouncing *those which we have seen* to be optical illusions, from the accidental *alignement* of the sides of the teeth in different grooves, when similarly illumined by oblique rays. When the scales are immersed in diluted sulphuric acid, we have never seen the diagonal lines. When the sulphuric acid is too strong, the scales curl up, and often in this state exhibit the lines very beautifully. We have observed diagonal lines singularly developed in the laminæ of the crystalline, and clearly arising from the interference of the rays acted upon by the lines on one side of the laminæ, with the rays acted upon by the lines on the other side, and therefore we have been the more confirmed in our opinion."

Fig. 14. *Scale of the menelaus butterfly.* This object consists of a fine tissue overlaid with strong and well defined lines. The latter are frequently detached from the membrane, as shown in our specimen; and consequently, there can be no illusive misconception regarding these lines, which are evidently fine fibrous cords in relief, upon the surface of the scale.

Fig. 15. This is a very singular scale, observed amongst a miscellaneous group. The longitudinal striæ are strongly defined, and the cross markings arise from a contraction, or shrivelling up, of the membraneous part between each two of the striæ.

Fig. 16. *Scale of the azure blue butterfly.* The light coloured and most diaphanous scales of this species form beautiful test objects for the microscope. The striæ are delicate, but are easily developed by a good doublet.

Fig. 18. *Scale of the lepisma.* The striæ on this object are easily defined, and they have the same character with those on the scale of the menelaus, as is evidenced by the partial detachment of the lines from the membraneous tissue. There is a variety in these scales: the one we have selected, and on which the markings are more delicate, is nearly oval-shaped; but there are others much resembling a shell, and having the upper edge scalloped very regularly. Diagonal markings are perceptible on the latter species, produced by undoubted spiny projections from the longitudinal fibres.

Fig. 19. *Scale of the diamond beetle.* The elytra, or wing case, of the diamond beetle is a splendid opaque object, familiar to every possessor of a microscope. We may compare the appearance it presents to that of the ancient Jewish breast-plate; a number of small cavities regularly disposed over the surface, are filled with a vast number of small scales, which reflect every variety of hue, and exhibit a lustre and magnificence that dims the splendour of the most richly arranged jewellery. Our figure shows one of these minute scales, with its semi-opaque spots and striæ; the latter, it will be noticed, have precisely the same character with figs. 10. and 11.

Fig. 20. *The scale of a moth.* This object is very opaque compared with preceding ones, and it is consequently difficult to trace its structure with much precision. The contour, it will be seen at once, is that of a leaf; and the vegetable analogy would seem to extend much further. This scale appears to consist of a fibrous frame-work, resembling very much the skeleton of a leaf; and the interstices are filled up with a mossy substance, whilst the prismatic reflections and other characteristics of the surface would indicate that smaller scales are scattered over it.

Fig. 21. *Disposition of the scales.* This is a small diagram, intended to convey an idea of the disposition of the scales on the membrane of a butterfly's wing. The double lines of points mark the places where the scales are inserted; and it will be noticed,

that there are two sets of them, one considerably shorter than the other. The longer scales are inserted in the upper line, overlapping each other, and the shorter, in the line beneath; by which means these extend to the middle of the long scales, and have their extremities covered by the next line.

We shall notice only one other remarkable appendage to some of the insect tribes, namely, the *sting*; the properties and mechanism of which are worthy of consideration. The sting of an insect is a weapon with which nature has armed it for purposes of self-defence; in no instance, we believe, is the sting resorted to unless the insect has an instinctive sense of danger, or has suffered provocation; and, indeed, this may be inferred from the fact, that the creature frequently inflicts fatal injury on itself, when it strikes this weapon into its opponent; for from the barbs on the sides, it is not able readily to disengage the sting, and not unfrequently, by using desperate efforts to obtain release, the insect tears out a portion of its entrails. There are three distinct parts connected with an insect's sting, each worthy of attentive examination; these are, the sheath, the darts with their barbs, and the poison bag. The following description of the sting of a bee, extracted from Adam's Essays on the microscope, will serve as a general exemplification.

"The apparatus consists of two piercers conducted in a sheath, groove, or director. This groove is rather large at the base, but terminates in a point; it is affixed to the last scale of the upper side of the abdomen by thirteen thin scales, six on each side, and one behind the rectum. These scales inclose the rectum all round, and are attached to each other by thin membranes, which allow of a variety of motions; three of them are, however, attached more closely to a round and curved process, which comes from the basis of the groove in which the sting lies, as also to the curved arms of the sting, which spread out externally. The two stings may be said to begin with these two curved processes at their union with the scales, and converging towards the groove at its base, which they enter, and then pass along to its point. The two stings are notched or serrated towards the point; they can be thrust out a little way, and drawn within it. These parts are all moved by very strong muscles, which give motions in almost all directions, but most particularly outwards. It is wonderful how deep they will pierce solid bodies with this sting. To perform this by mere force, two things are necessary—power of muscles and strength of sting; neither of which they seem to possess in a sufficient degree. Mr J. Hunter thinks that it cannot be by simple force, because the least pressure bends the sting in any direction. It is probable that the serrated edges may assist, by cutting their way like a saw. The apparatus for the poison consists of two small ducts, which are the glands that secrete the poison; these lie in the abdomen among the air cells, they soon, however, unite into one oblong bag; at the opposite end of which a duct passes out, which runs towards the angle where the two stings meet, and, entering between them, forms a canal by the union of the two stings at this point. From the serrated construction of the stings, the bee can seldom disengage them, and hence, when they pass into materials of too strong a nature, the bee generally leaves them behind, and often a part of the bowels therewith."

The poison bag is shown in the annexed cut.



We pass on to notice a few insects which are purely microscopical, and require optical aid to render their entire figure sufficiently distinct for observation. And here, it must be obvious, our remarks will necessarily be of a very cursory description, and our illustrative instances few; for this one department of our chapter would furnish, if carried out to its full extent, a large and closely printed volume.

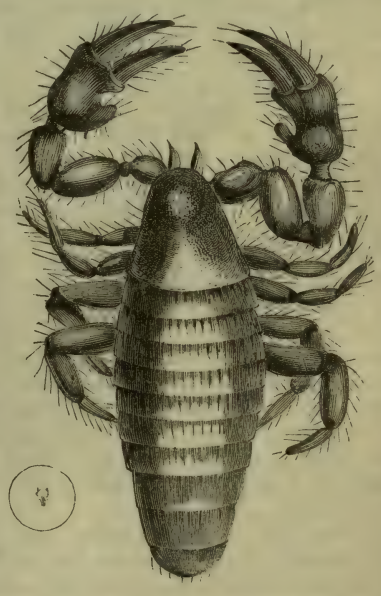
Amongst *microscopical insects*, the monoculus, or water flea, holds a distinguished place. This insect belongs to the crab genus. So numerous is it, in the summer months, that the ponds appear tinged with red or green, owing to the myriads of these minute creatures upon their surface. When full grown, some species of the water flea are about the size of a common flea[1] This insect appears to have but one eye, which, however, is compound, and at the same time movable by muscles in the manner of the human eye. The young, perfectly formed, may sometimes be seen within the parent. Mr Pritchard calls

[1] The *Monoculus Polyphemus* is the largest of all insects, measuring four feet in length; this, however, lies beyond our province, which confines us to the minute.

the attention of the microscopic observer to "the numerous muscles for moving the body, and its elegant branched arms,—the disposition of those for producing a revolution of its compound eye,—the position of those for raising and depressing the respiratory organs, and others for contracting and dilating the pulsatory organ. The curious form of its shell, and the various shapes of the reticulations on different parts of its surface,—the articulations of its arms—the singular construction of its digestive organs—the circulation of its blood, and the delicate fringes appended to its branchiæ, afford ample materials for observation." A very faithful illustration of the *Monoculus quadricornis* will be found in a future page, in connection with the *Vorticella digitalis*, which frequently attaches itself to the body of this insect.

The *Lepisma* forms a genus in that order of the insect class named *aptera;* and includes several varieties or species. The small *book-worm*, as it is popularly called, ranks under this genus: it is one of the most pleasing and interesting microscopic objects known, whether it be viewed in detail or observed entire. No one seems to have examined this little creature with more attention than Hooke, whose description is so popular and curious that we offer it as the best account which can be given of the insect. "It is," says he, "a small, white, silver-shining worm, which I found much conversant among books and papers, and is supposed to be that which corrodes and eats holes through the leaves and covers; it appears to the naked eye a small, glittering, pearl-coloured moth, which upon the removing of books and papers in the summer, is often observed very nimbly to scud, and pack away to some lurking cranny, where it may the better protect itself from any appearing dangers. Its head appears big and blunt, and its body tapers from it towards the tail, smaller and smaller, being shaped almost like a carrot. This the microscopical appearance will more plainly manifest, which exhibits a conical body, divided into fourteen several partitions, being the appearance of so many several shells or shields that cover the whole body; every one of these shells is again covered or tiled over with a multitude of thin transparent scales, which, from the multiplicity of their reflecting surface, make the whole animal appear of a perfect pearl colour. This, by the way, offers a reason for the appearances presented by these scales, as also by mother-of-pearl, and a multitude of other shelly sea-substances; for they each of them consisting of an infinite number of very thin shells or laminated orbiculations, cause such multitudes of reflections, that the composition of them, together with the reflection of others that are so thin as to afford colours, gives a very pleasant reflection of the light. The small blunt head of the book-worm was furnished on either side of it with a cluster of eyes, each of which seemed to contain but a very few, in comparison of what I had observed the clusters of other insects to abound with; each of these clusters was beset with a row of small bristles, much like the *cilia*, or hairs, on the eyelids, and perhaps they served for the same purpose. It had two long horns before, which were straight, and tapering towards the top, curiously ringed or knobbed, and bristled much like the marsh weed, called horse-tail, or cat's-tail, having at each knot a fringed girdle of smaller hairs, and several larger bristles, here and there dispersed among them; besides these, it had two shorter horns or feelers, which were knotted and fringed just as the former, but wanted bristles, and were blunt at the ends; the hinder part of the creature was terminated with three tails, in every particular resembling the two longer horns that grew out of the head: the legs of it were scaled and haired much like the rest." The singular scales of this small insect have already been illustrated and described.

The *lobster insect*, represented in the annexed cut, is figured and described by Adams in



his Essays on the microscope. This insect approximates in form and character to the *phalangium cancroides* of Linnæus; it presents, however, many remarkable points of difference, and forms a microscopic object of great variety and interest. We take Adams' description as the best we can offer,—"This extraordinary little creature was found by my ingenious

friend Mr John Adams, of Edmonton. He was at the new Inn, Waltham Abbey, where it was spied by some labouring men who were drinking their porter. The man who first perceived it, thought it was of an uncommon form; on a more minute inspection it was supposed to be a pediculus with unusually long horns; others thought it was a mite. This produced a debate, which attracted the attention of my friend, who obtained the insect from them for further observation. Mr Martin has given some account of it, in the third volume of the "Young Gentlemen and Lady's Philosophy." Mr Adams favoured me with the insect, that an accurate drawing might be taken from it, which I thought would be highly pleasing not only to the lovers of microscopic observations, but also to the entomologist. It appears to be quite a distinct species from the *phalangium cancroides*, of which a good drawing has been given by Hooke, Rösel, Schæffer, &c. It has also been described by Scopoli, Geoffroy, and other naturalists; not one, however, of these descriptions agrees with the animal under consideration. The abdomen of this is more extended, the claws are larger and much more obtuse; the body of the other being nearly orbicular, the claws slender, and finishing almost in a point, more transparent and of a paler colour. It is very probable that there are several species nearly similar. Mr Marsham has two in his possession, one like the drawings of Reaumur, the other not to be distinguished from that which is represented in the annexed figure, except that it wants the break or dent in the claws, so conspicuous in this. The latter he caught on a flower in Essex, the first week in August, firmly affixed by its claws to the thigh of a large fly, and could not disengage it from thence without considerable difficulty; to accomplish which he was obliged to tear off the fly's leg, and was much surprised to see the bold little creature spring forward full a quarter of an inch, and once more seize its prey, from which it was again with much difficulty disengaged." The insect is shown in the cut considerably magnified; an indication is also given of the natural size.

"According to Aldrovandus, this insect was not unknown to Aristotle, who mentions it as being found in books and papers. Wolphius, on the authority of Gesner, says that a few are to be met with in some parts of Switzerland. Scaliger also notices it, having found two of them in his books. It has been by various systematic writers referred to different genera: De Geer has instituted a new genus for it under the name of *chelifer*; Frabricius has remanded it to that of *scorpio*, to which perhaps it is more nearly allied than any other. Amongst the number of naturalists who have observed and described the insect, it appears rather extraordinary that none have met with one similar to that in the cut, in respect to the break in the claws. In a cabinet of curious microscopic objects which I purchased several years since, and which originally came from Holland, there were four of them in the most perfect condition. A botanical friend, Mr Young, also favoured me with a living one which he found among some plants collected by him in one of his excursions; but as his box contained a variety of plants, and he did not discover the insect till his return, it was imposible to ascertain the particular one on which it was taken. All these resembled the one exhibited, excepting the claws being longer and more slender, and being deficient in the distinguishing characteristic. I have lately seen another, in which the two fangs that are shown highly magnified in plate 85 of the Naturalist's Miscellany, are very apparent, being so large, as to exceed in diameter the thickest parts of the claws. Rösel says, this insect dwells among paper, in old books and their bindings, in chests of drawers, and in the crevices of old buildings. In order to discover whether the insect possessed a sting, he often, by various means, endeavoured to irritate it; but it never showed the smallest inclination to defend itself; on the contrary, it always endeavoured to avoid a contest; if so, it evidently appears that those few met with in this country are of a more bold and warlike disposition. Seba asserts that these insects resemble the large scorpions, the tail excepted, which is small, and usually concealed by being drawn close to the under part of the abdomen; but in this respect he must probably have been mistaken, as it does not appear that this circumstance has been noticed by any other person."

We have now extended this chapter much beyond what was originally intended, yet have found our space insufficient for so particular a detail of the microscopic formations and phenomena of the natural world as we could have wished to give. It will be obvious, that a separate volume alone could embrace a complete survey of the minute in nature: what we have done, however, will present under a systematic form a general outline of the discoveries that have been made by means of the microscope, and may lead the student in natural history to give deep regard to the atomic elements of material bodies; it may also increase his admiration and reverence for the Great Creative Power from whom all things proceed, when he perceives that Deity, unconfined by the relative terms of large and small, can display an equal share of plastic energy in the atom, whose existence the un-

aided eye of man cannot detect, and the most colossal animated structure that walks the globe. An examination into the minute has a manifest tendency to strengthen belief in an universal and particular Providence, and affords a striking comment on the declaration of Holy Writ, that "not a sparrow falleth to the ground without the knowledge of our heavenly Father."

CHAP. II.

INFUSORIAL ANIMALCULES.

The elaborate examinations that have recently been made regarding infusorial animalcules have brought vast accessions to our knowledge of animated nature. Of these atomic germs of vitality, little had been previously discovered beyond the fact of their existence; and indeed, many species, on account of their extreme minuteness, and the vast amplifying power necessary for their developement, had not till very recently been observed at all. It is not however to their mere existence that the microscopist now calls attention, but to all the details of their external form and internal structure; to their habits, modes of action, natural instincts, and to all the economy of their being. The mind is overwhelmed and confounded whilst we read (as Mr Pritchard, in his *Natural History of Animalcules*, has enabled us to do) of the organization and vital properties of a living atom, so inconceivably minute, that five hundred millions of them in a mass, would present little more than a sensible point to the unassisted eye. Such an announcement will be met by much scepticism; and scepticism, in this instance, is indeed pardonable; for with the object before him, the observer can scarcely yield his belief, whilst mathematical truth and actual observation are attesting the fact.

The term *infusorial* is applied to the various species of animalcules discovered in vegetable and animal infusions. They exist naturally in all stagnant waters, wherein vegetable or animal matter is decomposing; and they can be produced artificially by making an infusion of vegetable substances, and suffering it to stand till it has fermented, and become in some degree putrid. The most rational and philosophical way of accounting for the presence of animalcules in infusions, is to adopt the hypothesis that the atmosphere is teeming with minute germs of animal and vegetable life,—that they form part of every thing we taste or touch, but that, for their perfect development, a suitable nidus is necessary, which nidus is presented in an infusion of some kind or other. These animalcular ova, it would appear, depend much for the form they are to assume when evolved, upon the peculiar nidus in which they are deposited; for the same infusion, in different stages of fermentation and putrescence, developes different species of animalcules. Or, perhaps, the ova themselves have distinct characters, and the infusion may become successively adapted for the developement of the various species. Leaving this point as one of mere conjecture, we pass on to observe that optical science has rendered these animalcules legitimate subjects of natural history: and we are consequently to acquaint ourselves, as before observed, not only with their extreme littleness, but with all the peculiarities that constitute their generic and special differences.

Before entering upon a particular description of the various kinds of animalcules found in infusions, we shall lay before the reader Mr Pritchard's lucid and perspicuous summary of their peculiarities.

"The term *animalcule*, which implies nothing more than the diminutive of animal, has been commonly used to denote those living creatures inhabiting fluids, which are too minute to be scanned, or even seen by the naked eye: such, for instance, as those produced in inconceivable numbers from infusions of animal and vegetable matter: it comprehends as well such as are found in, and are peculiar to, the bodies of larger animals: this latter class, however, does not fall within our province.

"In the variety of systems that have been put forth respecting these creatures, the main characteristics of each have referred either to a difference in their size, or to the general appearance of their external forms: the present design, however, is not to investigate the value of these. Until the introduction of vegetable colouring matter into the fluid which supplies them with food—an experiment that has been attended with very successful results—these creatures were commonly supposed to be entirely devoid of internal organization, and to be nourished by the simple process of cuticular absorption. By the application of coloured substances, which, moreover, have been found to invigorate rather than to depress the animalcule, and to maintain it in the full exercise of all its functions, this erroneous notion is set at rest, and an internal structure is discerned in some, equal to, if not surpassing that of the larger invertebrated animals, and comprising a muscular, nervous, and, in all probability, vascular system; all wonderfully contrived for the performance of their respective offices.

"The most obvious portion of their internal structure is undoubtedly that connected

with the digestive functions; and hence it is that Ehrenberg has selected this as the leading feature of his arrangement, denominating his two grand divisions of the Phytozoa,—Polygastrica and Rotatoria; the former of which implies such as are possessed of several distinct stomachs or digestive sacs; and the latter such as have true alimentary canals and rotatory organs provided with a number of cilia aptly disposed for promoting the objects of life: these two grand divisions of the Phytozoa are afterwards subdivided into families and other minor branches. The *cilia*, in their different combinations, supply the means of locomotion, propelling the creature, in many cases, with great rapidity through the water: they are apparently stiff like eye-lashes; and from Dr Ehrenberg's description of some of the larger ones, they issue from bulbous substances at their bases, and being acted upon by muscular fibres, are capable of being moved to and fro in particular directions, so as to occasion a current of the fluid to flow towards the mouth of the animalcule, by which it is furnished with fresh water or food. They are sometimes disposed, as before stated, round certain organs of a circular form, which, on account of their peculiar vibrations, giving the appearance of a rotatory action, are termed rotatory organs. A second curious feature in the construction of some of these minute creatures are the *setæ*, or bristles, attached to the surface of their bodies: these short movable hairs in all probability act as fins, and contribute greatly to their means of motion. The third feature, are the *uncini*, or hooks, setaceous appendages curved at their extremities, and serving the creature to attach itself to any object it chooses. A fourth are the *styli*, jointed at their bases, and differing from the cilia in respect of their being unable to effect a rotatory motion: these, however, are more flexible, and have more play, than the setæ. Independently of these peculiarities, some animalcules possess the extraordinary faculty of thrusting out, or elongating, portions of their bodies at various points, which, assuming the appearance either of legs or fins, are termed *variable processes*, and enable the creature to walk or swim.

"It was a favourite hypothesis, with naturalists, some years ago, that the class of animalcules under consideration was entirely nourished by cutaneous absorption, and that no suitable organs for transmitting and digesting food were discoverable. Baron Gleichen was the first who brought the truth of this theory to the test; for having tinged some water containing animalcules with carmine, he found on the second day that only some distinct cavities, in the interior of their bodies, were filled with the colouring matter, evidently demonstrating the existence of an alimentary structure: here however, he left the subject, and it is to Dr Ehrenberg's further investigation of it that we are indebted for an accurate description of their different forms. In more recent experiments, it has been found advisable to employ vegetable colouring substances in their pure state; such, for instance, as sap-green and indigo, which, together with the valuable accession of an excellent instrument, enabled the doctor to contribute much to our previously imperfect knowledge of this branch of natural history.

"In the selection of vegetable substances for infusions (for procuring animalcules) such as stalks, leaves, flowers, seeds of plants, &c., care must be taken that there be no admixture of quinine (bark) in them, or the intention will be frustrated. Immerse these, whatever they may be, for a few days, in some clean water, when, if the vessels which contain them be not agitated, a thin pellicle, or film, will be discerned on the surface, which, under the microscope, will be seen to be inhabited by several descriptions of animalcules: the first produced are commonly those of the simplest kind, called *monads*. In a few days more, their numbers will increase to such an amazing extent, that it would be utterly impossible to compute those in a single drop of the fluid. After this again, they will begin to diminish in numbers, and I have generally observed them supplanted by others of a larger species and more perfect organization; such as the *cyclidia*, *paramesia*, *kolpodæ*, &c. It is worthy of remark here, however, that in their production they do not pursue any regular order, even in similar infusions. If the vessel be large, and the circumstances under which it is placed sufficiently favourable, a still higher description of animalcules will succeed, viz. the *vorticella*, and lastly the *brachioni*; and thus a single infusion will repay for the little trouble of making it with a great variety of species. Water in which flour has been steeped will be found to abound also with animalcules: and it is remarked by G. Leach, Esq., that the leaden troughs, constantly appropriated for birds to drink out of, contain several descriptions of them, and more especially those of the wheel genus. In ponds, too, especially in the shallow parts, near the edges, and in the immediate vicinity of water plants, prodigious quantities of all kinds may be easily procured; so that possessing as we do such myriads of them all around us, that they impregnate almost everything that we eat, drink, touch, and breathe, an anxiety to know more about them, and the effects they produce, cannot but be regarded as rational and laudable."

"By a careful inspection of the drawings,"

(Mr Pritchard here refers to the elaborate engravings illustrating his *Natural History of Animalcules*), "it will be noticed that some animalcules resemble spheres; others are egg-shaped; others again represent fruits of various kinds—eels, serpents, and many of the invertebrated animals; funnels, tops, cylinders, pitchers, wheels, flasks, &c. &c; all of which are found to possess their own particular habits, and to pursue a course of life best adapted to their peculiar constructions: thus, for instance, whilst some move through the water with the greatest imaginable rapidity, leaping or swimming, others merely creep or glide along; and many are altogether so passive, that it requires long and patient observation to discover any of their movements at all. One description are perceptibly soft, and yield easily to the touch; another are covered with a delicate shell or horn-like coat. Of the latter order there are different degrees of density, as in the volvox, gonium, &c., where the envelope is comparatively thick; and where, strange to say, the internal substance separates by the mode of propagation into several portions, forming so many distinct young ones, which at their birth burst the envelope, and the parent becomes entirely dissipated. In others of this order the shell is merely a plate covering the body, resembling that of the tortoise: sometimes it includes the body, so as to leave only two small apertures at the extremities, and at others it is bivalved, and incloses the creature, like that of the oyster or muscle.

"All vertebrated animals are either oviparous or viviparous, which terms sufficiently designate their modes of production: but it is not so with animalcules; for, in addition to these two methods, 1. Animalcules propagate by a spontaneous scissure, or division of their bodies into two or more portions, each one forming a new creature, which, on its arrival at maturity, pursues the same course. These divisions take place in some genera symmetrically, as in the gonia, &c.; in others by transverse, longitudinal, or diagonal sections. In these latter cases the produce have forms differently proportioned from those of the creatures from which they spring. 2. They propagate, in the manner before mentioned of the volvox, and some other genera, by a distribution of the internal substance of the parent into a proportionate number of young ones, all of which at their birth issue forth, and leave behind them nothing but the envelope, soon to be dissolved. 3. They are produced by germs, shooting forth from the parent's sides. 4. From spawn, which in the act of being shed, carries along with it a portion of the parent animalcule."[1]

We have not space to admit the detail of a variety of additional and highly interesting particulars relative to the infusoria that are recorded by Ehrenberg. We may, however, briefly state that the learned professor has succeeded in developing the mouths and *teeth* of these minute creatures, and has even ascertained the number of the latter, their consistency, and characteristic differences. He has found them to be provided with assistant organs of digestion, respiratory organs, and a perfect vascular and nervous system. Even the eyes of these tiny objects have been made the subject of his examination, and many remarkable particulars concerning them have been ascertained. Regarding their fecundity, it is sufficient to state, on the professor's authority, that a single animalcule will in the course of three or four days become a multitude of separate existences, of whose number the human mind can form no idea.

"Motion," says Adams, "seems to be the great delight of the infusoria; they pervade with equal ease and rapidity, and in all forms and directions, the whole dimensions of the drop, in which they find ample space for their various progressions, sometimes darting straight forward, at other times moving obliquely, then again circularly: they know how to avoid with dexterity any obstacles that might obstruct their progress. Hundreds may be seen in a drop of water in constant action, yet never striking against each other. If at any time the clusters prove so thick as to impede any of their motions, they roll and tumble themselves overhead, creeping under the whole range, force their way through the midst, or wheel round the cluster with surprising swiftness; sometimes they will suddenly change the direction in which they are moving, and take one diametrically opposite thereto. By inclining the glass in which the drop of water is laid, it may be made to move in any direction; the animalcules in the drop will swim as easily against the stream as with it. If the water begin to evaporate, and the drop to grow smaller, they flock impetuously towards the remaining part of the fluid; an anxious desire of attaining this momentary respite of life is very visible, as well as an uncommon agitation of the organs by which they imbibe the water. These motions grow more languid as the water fails, till at last they entirely cease.

"Animalcules and insects will support a great degree of cold, but both one and the other perish when it is carried beyond a certain point. The same degree of heat that destroys the existence of insects, is fatal to animalcules; as there are animalcules produced in water at the freezing point, so there are insects which live in snow."

[1] Natural History of Animalcules, Book I. p. 12—20.

We proceed to give Müller's scientific arrangement of the infusoria, connecting with each genus the individual selected for illustration of special character.

I. Those wanting external organs.

1. *Monas:* punctiforme. A mere point. Drop Monad. Pl. 35, fig. 65.—2. *Proteus:* mutabile. Mutable, or changeable. Melting Proteus, f. 66.—3. *Volvox:* sphœricum. Spherical. Vegetable Volvox, f. 67.—4. *Enchelis:* cylindraceum. Cylindrical. Egg-shaped Enchelis, f. 61.—5. *Vibrio:* elongatum. Long. Stick Vibrio, f. 68.

Membranaceous.

6. *Cyclidium:* ovale. Oval. Azure Cyclidium, f. 62—7. *Paramœcium:* oblongum. Oblong. Paramœcium chrysalis, f. 63.—8. *Kolpoda:* sinuatum. Crooked or bent. Cuckoo Kolpoda, f. 64.—9. *Gonium:* angulatum. With angles. Breast-plate Gonium, f. 69.—10. *Bursaria:* hollow like a purse. Little Swallow-like Bursaria, f. 60.

II. Those that have external organs.

Naked, or not inclosed in a shell.

11. *Cercaria:* caudatum. With a tail. Green Cercaria, f. 59.—12. *Leucophra:* ciliatum undique. Every part ciliated. Bracelet Leucophrys, f. 54.—13. *Trichoda:* crinitum. Hairy. Trichoda vulgaris, f. 55.—14. *Kerona:* corniculatum. With horns. Kerona pullaster, f. 56.—15. *Himantopus:* cirratum. Cirrated, or curled. Himantopus larva, f. 58.—16. *Vorticella:* ciliatum apice. The apex ciliated. Vorticella cyathini, f. 57.

Covered with a shell.

17. *Brachionus:* ciliatum apice. The apex ciliated. Brachionus passus, f. 53.

I. Monads. An invisible,[1] simple, pellucid, punctiform worm.

Among the various animalcules which are discovered by the microscope, these are the most minute, and the most simple. The *monad* is a small jelly-like point, eluding the powers of the compound microscope, and even of the single one until the recent improvements in lenses had added large additional power. "This genus includes the smallest forms in which a voluntary motion has been observed, even under the most powerful microscopes: this motion, till lately, appeared to be the only property of life with which they were endowed; but the observations of Dr Ehrenberg demonstrate an organization equally perfect with animated beings of much larger dimensions. Their forms in general are simple, spherical, or cylindrical masses, devoid of external members, or processes; the mouth, which is with difficulty discerned, is a simple orifice, not furnished with ciliæ, or hairs, (except in one or two species): they are colourless, and transparent as the clearest crystal, yet can no internal organization be seen, excepting that connected with their digestive function, which consists of two or more globular cavities, or sacs, probably communicating with each other by a tubular membrane, as in the larger polygastric animalcules, but which in this genus is too minute to be discerned; indeed, the stomachs or sacs themselves are only to be observed when the animalcule is fed with particles of colouring matter: the food on which they usually exist being as pellucid as themselves, the cavities are invisible. They increase by a spontaneous division of the parent into two or more parts, and those parts, or young, again divide when they have attained their full age. As subjects of observation, the *monads* are principally interesting from their minuteness, being as they are the very limit of man's acquaintance with animated nature. Their diameters vary from 1-24000th of an inch to 1-1200th, and consequently require a very high magnifying power to discern. They are numerous, and generally found congregating at the surface and around the decomposed matter of infusions, either of vegetable or animal substances."

To enter into particular description of the various species included under the monad genus, would require more space than we can devote to the subject: and, indeed, of all the genera, we shall content ourselves with giving one, or at most two or three, special illustrations, adding a list only of the remaining species, with their distinguishing characteristics appended to each.

Plate 35, fig. 65. *The Drop Monad.*—"This animalcule is larger than the *atom* monad, and somewhat globular. On account of its size and transparency, its digestive cavities can be much more distinctly observed. It revolves about its longer axis, and in swimming, that part which contains the coloured particles follows the colourless part. Occasionally, with attentive observation, currents in the water may be seen about the fore part or mouth; it is therefore highly probable that it is furnished with ciliæ or hairs. Those found at Petersburgh measured from 1-3000th to 1-2300th of an inch in diameter: they are represented in the group magnified 380 times."[2]

Monad species.

1. *Monas termo.* A mere point.—2. *Monas atomus, et lens.* Two species, the first appearing a simple white point, and the second presenting a shining talc-like appearance.—3. *Monas punctum.* Mere dark points, assuming under a deep power the form of short cylinders, and sometimes exhibiting a slender filament or tail.—4. *Monas guttula.* The Drop Monad. Described.—5. *Monas mica.* A lucid point, assuming sometimes a spherical, at others an oval form.—6. *Monas tranquilla.* Egg-shaped.—7. *Monas lamellula.* Of a white colour, mostly found in salt water.—8. *Monas pulvisculus.* Transparent, with a green margin.—9. *Monas uva.* In clusters like grapes.—10. *Monas crepusculum.*—11. *Monas*

[1] By invisible, is here meant indiscernible by the naked eye.

[2] Mr Pritchard, to whom we are indebted for much of our information in this department, expresses the magnifying power in linear measure, i. e. by the magnified diameter.

enchelis. Flask-shaped.—12. *Monas erubescens.*—13. *Monas hyalina.*—14. *Monas kolpoda.*—15. *Monas Ovalis.*—16. *Monas polytoma.*—17. *Monas umbra.*—18. *Monas volvox.* Revolving monad.

II. Proteus. An invisible, very simple pellucid worm, of a variable form.

"We now arrive at a larger class of animalcules, whose habits are highly interesting and curious: indeed there are few in the examination of which I have been more delighted. This gratification arises not so much from any complexity in their organization, which in comparison with the Brachionus, and some of the Vorticella, is more simple, but from the great power they possess of dilating their bodies; and their motions being slow, the observer is enabled to examine their changes of form distinctly."

Fig. 66. *The melting Proteus.*—"The drawing of this animalcule was taken from a specimen found in some water containing duck-weed (*lemna major*), in the month of March. Müller states he only saw them twice. Their diameters vary from 1-600th to 1-300th of an inch."

Proteus species.

1. *Proteus diffluens.* Branching itself out in a variety of directions.—2. *Proteus Tenax.* A globular mass, extending a process terminating in a fine point.

III. Volvox. An invisible, very simple, pellucid, spherical worm.

"The animalcules belonging to this genus are of a globular form, and revolve in the water. Some of the species are so large as to be discerned by unassisted vision, while others are very diminutive. Ehrenberg has not demonstrated their digestive organization; but in a note to his table, conceives they ought to follow the monads. In this genus is included that beautiful animalcule, called the *volvox globator*, which forms so interesting a spectacle in the solar and gas microscopes."

Fig. 67. *The vegetable Volvox.*—"This animalcule is rather scarce. Its most interesting character is the short time which it requires in arriving at maturity, and undergoing all its changes. In the space of half an hour, when fed with an infusion of indigo, a single globule may be observed to emerge from a naked branch, increase in size, and divide into a cluster of smaller ones; these increase also, and after revolving, and bringing a current of food towards them, finally separate, and swim away, each of the young ones commencing a similar course. It consists of several opaque branches: at the termination of each is a small congeries of egg-shaped transparent bodies. Müller, who seems only to have seen them once, mistook them for a vegetable production, until he observed the clusters to separate from the branch, and swim about at pleasure."

"These animalcules produce a rapid current of water towards them, as indicated by the arrow in the figure; and if supplied with plenty of coloured food, as indigo, they will not only assume the colour of the particles, but may be seen to increase in size, under the eye of the observer. When the cluster is fully developed, it breaks, off, and swims away, revolving as it proceeds.—After roving about for a few minutes in search of a proper nidus to attach itself to, it spins a very delicate thread, like a spider's web, one end of which it fixes to the substance it has selected; this filament, when drawn out to the proper length, increases in size, and assumes the deep blue colour of the indigo, while the end of the stalk which it left shoots forth a new cluster. The current above mentioned is sometimes produced without any revolution of the cluster of globules; at other times I have observed the whole cluster to revolve. The magnifying power which I employed, while making the drawing of this figure, was nearly 500 times. The medium diameter of the clusters, while attached to their branches, I find to be about the 800th part of an inch; and when fully developed and separate, about 1-400th of an inch. Müller discovered these animalcules in river water in the month of November. Those on which the above observations were made I found in the month of June, in some pond-water."

Plate 27, fig. 35. *Volvox globator.*—Spherical membranaceous volvox.

This is a transparent globule, of a greenish colour; the fœtus is composed of smaller greenish globules. It becomes whiter and brighter with age, moves slowly round its axis, and may be perceived by the naked eye. But to the microscope the superficies of this pellucid membrane appears covered with molecules, as if it were granulated, which has occasioned some observers to imagine it to be hairy; the round pellucid molecules that are fixed in the centre are generally larger in those that are young. The exterior molecules may be wiped off, leaving the membrane naked; when the young ones are of a proper size, the membrane opens, and they pass through the fissure; after this the parent is dissipated. They sometimes change their spherical figure, the superficies being flattened in different places. Most authors speak of finding eight lesser globules within the larger; but Müller says, that he has counted thirty or forty of different sizes. This wonderful capsulate situation of its progeny is well known; indeed, it often exhibits a second and third generation within it. Leeuwenhoeck was the first who noticed this curious animal-

cule, and depicted it ; a circumstance which has not been mentioned by Baker, and other microscopic writers, who have described it. It may be found in great plenty in stagnant waters in spring and summer, and in infusions of hemp seed and tremella. Baker describes it as follows :—This singular minute water animal, seen before the microscope, appears to be exactly globular, without either head, tail, or fins. It moves in all directions, forward or backward, up or down, rolling over and over, like a bowl, spinning horizontally like a top, or gliding along smoothly without turning itself at all. Sometimes its motions are very slow, and at other times very swift ; and when it pleases, it can turn round as upon an axis very nimbly, without moving out of its place. The body is transparent except where the circular spots are placed, which are its young. The surface of the body in some is, as it were, dotted all over with little points, and in others, as if granulated like shagreen. Baker thought also that in general it appeared as if it were set round with short movable hairs. By other writers, they are thus described : These animalcules are at first very small, but grow so large as to be discerned with the naked eye ; they are of a yellowish green colour, globular figure, and in substance membranaceous and transparent. In the midst of this substance several small globes may be perceived ; each of these is a smaller animalcule, which has also its diaphanous membrane, and contains within itself still smaller generations, which may be distinguished by the assistance of very powerful glasses. The larger globules may be seen to escape from the parent, and then increase in size, as has been already observed.

Volvox Species.

1. *Volvox punctum.* Spherical, of a black colour, with a lucid point.—2. *Volvox granulum.* Spherical and green, the circumference of a bright colour.—3. *Volvox globulus.* Globular volvox, the hind part somewhat obscure.—4. *Volvox pilula.* Small round volvox, with immovable green intestines.—5. *Volvox grandinella.* Spherical and opaque, with immovable intestines.—6. *Volvox socialis.* Spherical volvox, with crystalline molecules, placed at equal distances from each other.—7. *Volvox sphæricula.* Spherical volvox, with round molecules.—8. *Volvox lunula.* An hemispherical volvox, with lunular molecules.—9. *Volvox globator.* Described.—10. *Volvox morum.* Membranaceous, orbicular, with Spherical green molecules in the centre.—11. *Volvox uva.* Globular volvox, composed of green spherical globules, which are not inclosed in a common membrane.—12. *Volvox vegetans.* Vegetable volvox. Described.

IV. Enchelis. An invisible, simple, cylindric worm.

" This genus of animalcules, according to Müller, contains twenty-seven species. The size of the different species varies considerably, and therefore requires different magnifying powers to develope them (from 200 to 500 linear.) If the reader have an opportunity of examining any of them, in instruments of different constructions, but of the *same* magnifying power, he will readily perceive there is something beyond mere amplification that is essentially requisite in a microscope, in order to show the details of objects."

Plate 35, fig. 61. *The Egg-shaped Enchelis.*—" This animalcule is distinguished by its pellucid appearance and the longitudinal folds of the external membrane. A few bright spots are also sometimes observed ; these have been supposed to be the ova, but it is more probable they are the sacs of the polygastric structure. The figure is a magnified representation, showing the sacs and folds, neither of which are constant. Found in stagnant water."

Plate 27, fig. 30. *Enchelis punctifera.*—Green enchelis, subcylindric, the fore-part obtuse, the hinder part pointed. This is an opaque animalcule, of a green colour. The hinder part is pellucid and pointed ; an incision is discovered at the apex of the fore-part, which seems to be the mouth. It is found in marshes.

Plate 27, fig. 45. *Enchelis retrograda.*—Transparent enchelis, the fore-part rather smaller, and terminating in a small globule. It has a gelatinous, diaphanous body ; no visible intestines, though a pellucid globule is discoverable near the hinder part ; the body is thickest in the middle, and grows smaller towards each end. It generally moves sideways, sometimes in a retrograde manner ; and if it be obstructed in its motion, draws itself up, as represented in the figure.

Enchelis Species.

1. *Enchelis viridis.* Green enchelis, of a subcylindric figure, the fore part truncated.—2. *Enchelis punctifera.* Described.—3. *Enchelis deses.* Green, cylindrical, gelatinous, the end somewhat pointed.—4. *Enchelis similis.* Egg-shaped, with opaque movable intestines.—5. *Enchelis serotina.* Partly oval, partly cylindrical, the interior parts immovable.—6. *Enchelis nebulosa.* Oval and cylindrical, with visible movable intestines.—7. *Enchelis seminulum.* Equally cylindric.—8. *Enchelis intermedia.* Cylindrical, transparent, with a blackish margin.—9. *Enchelis ovulum.* Egg-shaped. Described.—10. *Enchelis pirum.* Pear-shaped, the hinder part transparent.—11. *Enchelis tremula.* Oval, cylindrical, gelatinous.—12. *Enchelis constricta.* Sub-oval, crystalline, with a stricture in the middle.—13. *Enchelis pulvisculus.* Elliptic, with a congeries of green intestines.—14. *Enchelis fusus.* Cylindrical, both ends truncated.—15. *Enchelis fritillus.* Cylindric, the fore-part truncated.—16. *Enchelis caudata.* Body long, fore-part obtuse, hinder part diminishing into a kind of tail.—17. *Enchelis epistomium.* Long and cylindric, the fore-part slender and roundish.—18. *Enchelis gemmata.* Body cylindrical, upper part prolonged into a transparent neck, a double series of globules running down the body.—19. *Enchelis retrograda.* Described.—20. *Enchelis festinans.* Oblong, cylindrical, the ends obtuse, the fore-part transparent.—21. *Enchelis furcimen.* Cylindric, crooked and truncated at both ends.—22. *Enchelis index.* Like an inverted cone, one edge of the apex produced and forming an angle with the other part.—23. *Enchelis truncus.* Cylindrical, with a kind of head.—24. *Enchelis Larva.* Long, with two small nipples projecting from the middle of the body, one on each side.—25. *Enchelis spatula.* Striated, the fore-part transparent and of the shape of a spatula.—26. *Enchelis pu-*

pula. Cylindric, the fore-part papillary.—27. *Enchelis pupa.* Kind of ventricose cylinder, with a small nipple proceeding from the apex.

V. Vibrio. An invisible worm, very simple, round, and rather long.

"The extensive range of this genus, in regard to the structure, form, and size of the different species, offers great variety to the observer. It includes animalcules both membraneous and crustaceous: some as slight as a thread, others whose breadth nearly equals their length; some whose organization is so complete that modern naturalists have entirely excluded them from the phytozoa; and others, which are with difficulty distinguished from vegetables. To diminish somewhat the incongruities, without rendering the arrangement complex, I have separated them into three divisions. The first is the simplest, and requires a magnifying power of from 200 to 500 times to examine them; the second and third vary so much in size that some do not require half that power, and a few even less, being just discernible by the naked eye."

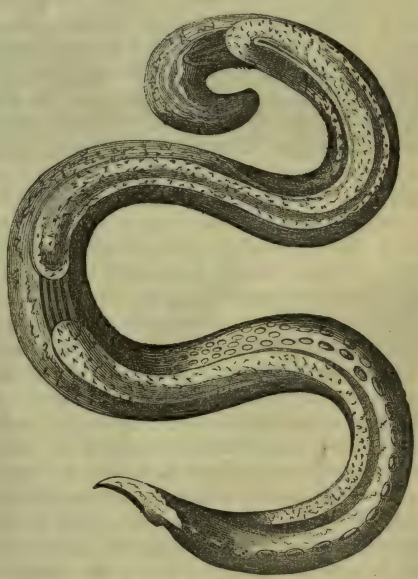
First Division,—*Bacillaria.* "These minute and inactive animalcules are covered with a hard, shell-like coat, and appear closely allied to some of the fresh-water algæ, and are not very appropriately classed with the vibrio.

Second Division,—*Phytozoa.* "This term was first made use of by Goldfuss, and is confined by Ehrenberg to those microscopic creatures whose digestive organs are polygastric, or if they possess a simple alimentary canal, it is always accompanied by rotatory organs."

Third Division,—*Entozoa.* Includes those animalcules of the vibrio genus which "possess an alimentary canal, but no cilia, nor occasion currents when immersed in a mechanical solution of coloured particles."

Plate 35, fig. 68, and Plate 27, fig. 30. *Paxillifer Vibrio.*—"This animalcule, or rather congeries of animalcules, for they are mostly attached together in different forms, when magnified appear like pieces of straw, of a pale yellow colour, with the inside of an orange brown. They are nearly round, and if attentively watched, may be seen occasionally to turn upon their longest axis, when a longitudinal line may be observed; this is probably the hinge or opening of their shell. They vary in length from 1-100th to 1-500th of an inch, their diameter is from 1-20th to 1-100th of their length: they require considerable magnifying power, and large angular aperture, to distinguish their structure. I find on reference to my notes, made at different times, that it was not until after I had examined them repeatedly I became satisfied of their animal vitality. They generally reside at the bottom of ponds, but after rain are met with near the surface, giving the water a green tint; in such cases they are found separate, the agitation of the water having broken the clusters." These animalcules are generally found collected together in different parcels, from seven to forty in number, and ranged in a variety of forms, sometimes in a straight line, then in the concave, as in fig. 30. This creature, usually known as the *stick vibrio*, seems to have affinity to the hair-like animal described by Baker.

Plate 27, fig. 44. *Vibrio Lunula.*—The bow, or moon-shaped, vibrio, having both ends similar. The body resembles much the shape of the moon at the first quarter; it is of a green colour, and has generally from seven to ten globules disposed lengthwise; the smaller ones are of a very pale colour, a pale green vacuity may sometimes be seen in the middle: some few varieties may be observed amongst them, which are not easily described; it will be enough to have given the reader their general and distinguishing characteristics.



The annexed cut represents a kind of vibrio found in wheat. These animalcules were discovered by Needham, and described by him in a work entitled New Microscopical Discoveries, and afterwards more fully treated upon by Baker. They are not lodged in those blighted grains which are covered externally with a soot-like dust, whose inside is often little more than a black powder; but abundance of ears may be observed in fields of corn, which have grains that appear blackish, as if scorched: these, when opened, are found to contain a soft white substance, that when attentively examined looks like a congeries of threads, or fibres, lying as close as possible to

each other in a parallel direction, and much resembling the unripe down of some thistles. This fibrous matter does not discover any signs of life, or motion, unless water be applied to it; the fibres then separate, and prove themselves to be living creatures. These vibrios are in general of a large size, and may be seen with a low magnifying power, being about 1-13th of an inch in length, and 1-140th broad. They are in general of a bright chestnut colour; the lower extremity is whiter and more transparent than the rest of the body. The upper end is rather round, the lower one is pointed. A distinguishing mark of these little creatures is a row of transparent globules, which are placed at intervals through the whole length of the body. These creatures increase in size, till at last they may be observed with great ease by the naked eye, being two-tenths of an inch long, and about one hundredth in diameter. The figure represents one of these magnified about seventy times linear. The ovary may be clearly traced almost from the lower extremity to the middle of the body, where the latter becomes so opaque as to prevent its being seen any farther. The eggs, when arrived at their full growth, are nearly of a cylindric shape, both ends rounded; towards the lower extremity there is an opening through which the eggs are extruded. The eggs are formed of a fine transparent membrane; it covers the young vibrio, which is folded curiously therein; these eggs may be frequently found in the grains of wheat containing the animalcules.

One of the most remarkable circumstances in these animalcules is the faculty they have of receiving again the powers of life, after having lost them for a considerable time; for instance, when some of the blighted grains of wheat, that have been preserved for many years, have been soaked in water for ten or twelve hours, living vibrios have been found in it; if the water evaporate, or begin to fail, they cease to move, but on a fresh application, will be again revived. It may be proper to notice here, that according to the observations of Roffredi, those eels which have done laying eggs are incapable of being resuscitated upon being moistened; the same seems to be the case with those that are very young; it is probable the animalcule must attain a certain age and degree of strength before it is endowed with this wonderful faculty.

VIBRIO SPECIES.

1. *Vibrio lineola.* Very small, linear vibrio.—2. *Vibrio rugula.* Like a bent line.—3. *Vibrio bacillus.* Linear, equally truncated at both ends.—4. *Vibrio undula.* Filiform, flexuous vibrio.—5. *Vibrio serpens.* Filiform, the windings obtuse.—6. *Vibrio spirillum.* Filiform, spiral.—7. *Vibrio vermiculus.* Twisted and gelatinous.—8. *Vibrio intestinum.* Gelatinous, round, the fore-part small.—9. *Vibrio bipunctatus.* Linear, both ends truncated, two small globules in the middle of the body.—10. *Vibrio tripunctatus.* Linear, smaller at the ends, with three globular points, the two which are at the extremities being smaller than the one at the middle.—11. *Vibrio paxillifer.* Described.—12. *Vibrio lunula.* Described.—13. *Vibrio verminus.* Linear, compressed, the fore-part narrower than the hinder part.—14. *Vibrio mallæus.* Linear, with a globule at the base, and transverse line at the apex.—15. *Vibrio acus.* Linear, with a neck, the upper extremity obtuse, the lower one terminating in a setaceous tail.—16. *Vibrio sagitta.* Linear, well-marked neck, apex truncated and open, tail setaceous.—17. *Vibrio gordius.* Of equal size, tail terminating in a little tubercle.—18. *Vibrio serpentulus.* Pointed at both ends.—19. *Vibrio coluber.* Filiform, tail setaceous, and bending up nearly to a right angle with the body.—20. *Vibrio anguillula.* Equal size throughout, and somewhat hard, various kinds, of which the wheat vibrio, described, is one, and the eels of vinegar another.—21. *Vibrio linter.* Ventricose oval vibrio, with a short neck.—22. *Vibrio utriculus.* Round, fore-part narrow and truncated, lower part ventricose.—23. *Vibrio fasciola.* Fore part small, middle larger, hind-part acute.—24. *Vibrio colymbus.* Thick, sharpened at the end, the neck a little bent.—25. *Vibrio strictus.* Lengthened out almost to a line, small towards the fore-part, apex obtuse.—26. *Vibrio anas.* Oblong, ends attenuated, neck longer than the tail.—27. *Vibrio cygnus.* Corpulent, with a crooked neck.—28. *Vibrio anser.* Elliptical, with a long neck, and a small lump on its back.—29. *Vibrio Olor.* Elliptical, with a very long neck, and a knob on the apex.—30. *Vibrio falx.* Gibbous, hind-part obtuse, neck crooked.—31. *Vibrio intermedius.* Membranaceous, fore-part small, hinder part somewhat acute.

VI. CYCLIDIUM. A simple, invisible, flat, pellucid, orbicular or oval worm.

"This genus is composed of animalcules of a flat, round or oval form, without any apparent cilia. Like some others, they are so very diaphanous that the most delicately finished engravings of them afford but a faint idea of their exquisitely brilliant, crystal-like appearance, when viewed under a good achromatic microscope of large angular aperture."

Plate 35, fig. 62. *The azure Cyclidium.*—"Is of a flat, oval form. In its usual condition it is pellucid, but when fed with colouring matter, dark spots may be seen as in the engraving, in swimming it sometimes rotates, and exhibits its narrow side to view; if the water be filled with opaque particles, a current may be perceived towards the front part of it, indicating the presence of cilia, which however can only be seen when the animal is expiring. These creatures propagate by division, during the progress of which they alter their form. They require a magnifying power from 600 to 800 times in order to view them distinctly. Length 1-1400th to 1-1800th of an inch."

CYCLIDIUM SPECIES.

1. *Cyclidium bulla.* Orbicular, bright.—2. *Cyclidium milium.* Elliptical, and crystalline.—3. *Cyclidium fluitans.* Oval, crystalline.—4. *Cyclidium glaucoma.* Oval, intestines faintly seen. Described.—5. *Cyclidium nigricans.* Oblong, with black margin.—6. *Cyclidium rostratium.* Oval, fore-part pointed.—7. *Cyclidium nucleus.* Oval, hind-part pointed.—8. *Cyclidium hyalinum.* Oval, hind-part acute.—9. *Cyclidium pediculus.* Oval, convex, the bottom even.—10. *Cyclidium dubium.* Oval, upper part convex, under part concave.

VII. Paramæcium. An invisible, simple, membranaceous, flat, and pellucid worm.

The animalcules included in this genus, together with the kolpoda, are supposed by Ehrenberg to be the same as the monads and cyclidia, at a more advanced stage of their growth.

Plate 35, fig. 63. *Paramœcium chrysalis.*—"These interesting creatures appear like milk-white specks to the naked eye. They are soft, and yield to the presence of any hard substance they may come in contact with. The body is long, and in some positions the cuticle appears to have a diagonal fold, as shown in the figure. The mouth aperture is situated on the inferior side, near the middle, and in some views it appears like a papillary projection. In good microscopes, the body is seen covered with longitudinal rows of hair; by means of these, the creature is enabled to produce a current in the water towards its mouth. They propagate by transverse division. These animalcules are well adapted for showing the structure of the alimentary organs, as they are of sufficient magnitude to render the sacs clearly distinguishable, when filled with coloured particles. On the introduction of indigo into the water they are greatly agitated; in a few minutes, however, they are quiet; and the digestive sacs become coloured, as in the figure, when from 100 to 200 may be enumerated. Length, 1-85th to 1-200th of an inch."

Paramæcium Species.

1. *Paramœcium aurelia.* Compressed, oblong, folded towards the fore-part, hinder part acute.—2. *Paramœcium chrysalis.* Cylindrical, folded towards the fore-part, hinder part obtuse. Described.—3. *Paramœcium versutum.* Cylindrical, lower part thick, both ends very obtuse.—4. *Paramœcium oviferum.* Depressed, with large oval molecules withinside.—5. *Paramœcium marginatum.* Depressed, gray, with a double margin.

VIII. Kolpoda. An invisible, very simple, pellucid, flat and crooked worm. "They vary much in external form."

Plate 35, fig. 64. *The cuckoo Kolpoda*, or *Common Bosom animalcule.*—"Its general contour has some resemblance to a bean; and if we suppose the two convex lobes on the front side equal, and do not perceive the proboscis, which indeed is seen with difficulty, we shall distinguish some likeness to the bosom; from which similitude it has received its name. The mouth, which is more lightly tinted than the surrounding parts, is situated in the hollow between the upper lobe and the proboscis, and marked by a cross, while the termination of the alimentary canal is in the cavity immediately below the proboscis. The margin of the two lobes is furnished with a row of delicate cilia, only observable under favourable illumination. These cilia, by producing a current in the water towards the mouth, perform the same important offices as members in some of the mammalia; as the current brings all the particles of matter in the water to the mouth in regular succession. By feeding these animalcules on vegetable colouring, the polygastric form of their digestive organs is readily distinguished. Length of full grown specimens, 1-280th of an inch. They are found in various vegetable infusions, and especially in those of hay which have been kept a considerable time."

Kolpoda Species.

1. *Kolpoda lamella.*—Elongated, membranaceous, hinder part curved.—2. *Kolpoda gallinula.* Oblong, back towards the fore-part bright and membranaceous.—3. *Kolpoda rostrum.* Oblong, the fore part hooked.—4. *Kolpoda ochrea.* Long, membranaceous, apex attenuated, base bent in a right angle to the body.—5. *Kolpoda mucronata.* Membranaceous, dilated, fore-part smaller than hind-part, with a small incision at one side.—6. *Kolpoda triquetra.* Egg-shaped, one edge turned back.—7. *Kolpoda striata.* Oblong, pear-shaped, white, fore-part pointed, hind-part round.—8. *Kolpoda nucleus.* Egg-shaped, with an acute vertex.—9. *Kolpoda meleagris.* Changeable, the fore-part like a hook, the hind-part folded up.—10. *Kolpoda assimilis.* Depressed, apex in the form of a small hook.—11. *Kolpoda cucullus.* Described.—12. *Kolpoda cucullulus.* Oblong, with an oblique incision a little below the apex.—13. *Kolpoda cucullio.* Flat, oval, bending slightly beneath the apex.—14. *Kolpoda reu.* Thick and curved in the middle.—15. *Kolpoda pirum.* Convex, oval, apex formed into a kind of beak.—16. *Kolpoda cuneus.* Clavated, round, the apex dentated.

IX. Gonium. An invisible, simple, smooth, angular worm.

"The animalcules of this genus are in clusters; they are propagated by several incisions across the body of the parent, dividing it into a number of symmetrical forms. When observed singly, most of the species resemble the volvox. The structure of their digestive organs is not known."

Plate 35, fig. 69. *The Breast-plate Gonium.*—"It consists of sixteen spherical bodies, disposed regularly in a quadrangular form, like the jewels in the breast-plate of the Jewish high-priest. They are all arranged in the same plane; the four centre ones are generally longer than those which surround them; and the diameters of the three smaller balls are only equal to the two larger centre ones to which they are attached; the external corners are therefore vacant. The diameters of the clusters vary from 1-3500th to 1-200th of an inch. They are found near the surface of clear water, and often along with the cercaria viridis. A magnifying power of 200 is sufficient for their examination."

Gonium Species.

1. *Gonium pectorale.* Quadrangular, pellucid, with sixteen spherical molecules. Described.—2. *Gonium pulvinatum.* Quadrangurlar, opaque, with four little pillows.—3. *Gonium Corrugatum.* Quadrangular, white, sunk a little in the middle.—4. *Gonium rectangulum,* Rectangular, hind-part arched.—5. *Gonium truncatum.* Gonium with obtuse corners, hind-part arched.

X. Bursaria. A very simple, hollow, membranaceous worm.

This animalcule takes its name from the resemblance its bears to a purse, or bag. Ehrenberg has noticed only one species, and has not decided as to the situation of the genus.

Plate 35, fig. 60. *The little swallow-like Bursaria.*—"The form of this animalcule, by a little effort of imagination, may be compared to a bird, and its movements appear like the flight of the swallow: hence its name. It is found in stagnant water."

Bursaria Species.

1. *Bursaria truncatella.* Ventricose, the top truncated.—2. *Bursaria bullina.* Boat-shaped, the fore-part formed into a lip.—3. *Bursaria hirundinella.* Described. 4.—*Bursaria duplella.* Elliptic, with the edge bent in and out.—5. *Bursaria globina.* Spherical, very pellucid in the middle.

XI. Cercaria. An invisible, pellucid worm, with a tail.

"If we consider the internal organization of this genus, it comprehends a very wide range; indeed, the different species vary so much that it is difficult to give a general definition of their characters with any degree of accuracy."

Plate 35, fig. 59. *The Green Cercaria.*—"This is a highly interesting creature: the bright green colour of its body; its diaphanous extremities; its well defined orange brown eye; and the numerous transformations of its form, render it a very interesting object for the microscope; in addition to which it is easily procured, and managed with great facility. The length of the specimen was about 1-350th of an inch: Ehrenberg gives 1-280th of an inch as their length. The magnifying power best adapted for viewing them, is from 300 to 500 times, in an achromatic."

Plate 27, fig. 29. *Cercaria inquieta.*—This animalcule so frequently changes its form, that it is not easy to describe it; it is sometimes spherical, sometimes like a long cylinder, at other times of an oval figure, white and gelatinous; the tail is filiform and flexible, the upper part vibrating vehemently; it has no visible viscera. Two small dots, probably the eyes, are sometimes distinguishable; and occasionally there is seen a large circular marking near the tail.

Cercaria Species.

1. *Cercaria gyrinus.* Round, with a sharp tail.—2. *Cercaria gibba.* Oval-shaped, convex, the fore-part rather acute, the tail round. 3. *Cercaria inquieta.* Described.—4. *Cercaria lemna.* Mutable, somewhat flattened, with an annulated tail.—5. *Cercaria turbo.* Globular, the middle contracted, with a tail like a bristle.—6. *Cercaria poduria.* Cylindric, the hind-part sharp and somewhat cloven.—7. *Cercaria viridis.* Described.—8. *Cercaria setifera.* Cylindric, fore-part smallest, hind-part pointed.—9. *Cercaria hirta.* Cylindric, fore-part somewhat truncated, lower part obtuse, finishing with two small points.—10. *Cercaria crumena.* Cylindric, ventricose, fore-part obliquely truncated, tail linear, terminating with two diverging points.—11. *Cercaria catellus.* Three-parted, tail divided into two parts.—12. *Cercaria catelina.* In three parts, with a short forked tail.—13. *Cercaria lupus.* Cylindric, long, the tail furnished with two spines.—14. *Cercaria vermicularis.* Cylindrical, annulated, with a projecting proboscis, two small spines for the tail.—15. *Cercaria forcipata.* Cylindric, wrinkled, with a forked proboscis, which it can extend or contract.—16. *Cercaria pleuronectes.* Orbicular, the tail consisting of one bristle.—17. *Cercaria tripos.* Triangular, two bent arms, and a straight tail.—18. *Cercaria cyclidium.* Oval, hind-part somewhat notched, with a tail that it thrusts out at pleasure.—19. *Cercaria tenax.* Membranaceous, fore-part rather thick, truncated, the tail three times shorter.—20. *Cercaria discus.* Orbicular, with a bent tail.—21. *Cercaria orbis.* Orbicular, with a tail consisting of two very long bristles.—22. *Cercaria luna.* Orbicular, the tail of two short spines, fore-part hollowed like a crescent.

XII. Leucophra. An invisible worm, pellucid, and every where ciliated.

Plate 35, fig. 54. *The Bracelet Leucophra.*—This animalcule is shown with the inner edge ciliated, sometimes the ciliæ are disposed on the circumference. It is scarce.

Plate 27, fig. 54. *Leucophra cornuta.*—This creature requires to be observed some time before its peculiar character can be ascertained; the body is composed of molecular vessels, of a dark green colour; for the most part it is like an inverted cone, the fore-part being wide and truncated, with a little prominent horn or hook on both sides; the hind-part conical, every where ciliated, the hairs exceedingly minute; those in the fore-part are three times longer than the latter, and move in a circular direction. The hinder part is pellucid, and sometimes terminates in two or three obtuse pellucid projections. This animalcule will at one moment appear oval, at another reniform, and ciliated at the fore part; but at another time the hairs are concealed. When the water evaporates, it dissolves or breaks into a number of molecular vesicles.

Leucophra Species.

1. *Leucophra conflictor.* Spherical, opaque, with movable intestines.—2. *Leucophra mamilla.* Spherical, opaque, with a small papillary projection.—3. *Leucophra virescens.* Cylindrical, opaque, the lower part much thicker than the upper part.—4. *Leucophra viridis.* Oval, opaque.—5. *Leucophra bursata.* Green, oval, the fore-part truncated.—6. *Leucophra postluma.* Globular, opaque, and covered with a kind of pellucid net.—7. *Leucophra aurea.* Oval, yellow, both ends equally obtuse.—8. *Leucophra pertusa.* Oval, gelatinous, apex obtusely truncated, one side sunk down.—9. *Leucophra fracta.* Long, with ciliated angles, rather flat.—10. *Leucophra dilatata.* Smooth, changeable, with a ciliated edge.—11. *Leucophra scintillans.* Oval, round, opaque, green.—12. *Leucophra vesiculifera.* Oval, with vesicular intestines.—13. *Leucophra globulifera.* Crystalline, of an oblong, oval shape.—14. *Leucophra pustulata.* Oblong, oval, the lower end obliquely truncated.—15. *Leucophra turbinata.* Like an inverted cone, and rather opaque.—16. *Leucophra acuta.* Oval, round, with the apex acute, mutable, yellow.—17. *Leucophra notata.* Oval, round, with a black point at the edge.—18. *Leucophra candida.* Oblong, one end smaller than the

other and bent back.—19. *Leucophra nodulata.* Oblong, oval, with a double row of little nodules.—20. *Leucophra signata.* Oblong, subdepressed, with a black margin, filled with little molecular globules.—21. *Leucophra trigona.* Thick, obtuse, angular, yellow.—22. *Leucophra fluida.* Kidney-shaped, ventricose. — 23. *Leucophra fluxa.* Reniform, sinuated.—24. *Leucophra armilla.* Described.—25. *Leucophra cornuta.* Described.—26. *Leucophra heteroclita.* Cylindrical, fore part obtuse, hind part furnished with a double tufted organ, which it can thurst in and out at pleasure.

XIII. Trichoda. An invisible, pellucid, hairy worm.

Plate 35, fig. 55. *Trichoda vulgaris.*—This animalcule has a crustaceous covering in the shape of a cup, at the circumference of which radiate several strong spines. Its polygastric structure may be seen in the figure.

Plate 27, fig. 37. *Trichoda sol.*—This splendid creature constitutes a new genus, but as we know of no more of the same kind, it is introduced here. It is a little crystalline, round corpuscule, the upper part convex; it is beset with innumerable diverging rays, which are no longer than the diameter of the body, proceeding from every part of its surface: the inside contains as many as twenty polygastric sacs. The body contracts and dilates, but the animalcule remains confined to the same spot.

Plate 27, fig. 38. *Trichoda cometa.*—A pellucid globule, replete with bright intestines, the fore-part furnished with hairs, the hind-part with a pellucid appendant globule.

Plate 27, fig. 53. *Trichoda bomba.*—A thick animalcule, and of a yellow colour; pellucid, and replete with clay-like molecules; it is very lively, moving about with so much velocity, as to elude the sharpest sight, and most determined observer, and assuming various shapes, sometimes appearing spherical, sometimes reniform, or kidney-shaped, and sometimes as in the figure.

Trichoda Species.

1. *Trichoda grandinella.* Spherical, pellucid, upper part hairy.—2. *Trichoda cometa.* Described.—3. *Trichoda granata.* Spherical, centre opaque, the circumference hairy.—4. *Trichoda trochus.* Pear-shaped, pellucid, each side of the fore part distinguished by a little bunch of hairs.—5. *Trichoda gyrinus.* Oval, round, crystalline, the front hairy.—6. *Trichoda sol.* Described.—7. *Trichoda solaris.* Spheroidal, with a few hairs round the circumference.—8. *Trichoda bomba.* Described.—9. *Trichoda orbis.* Orbicular, the fore part notched and hairy.—10. *Trichoda urnula.* In the form of a water pitcher, the fore part hairy.—11. *Trichoda diota.* Pitcher-shaped, fore part smallest, upper part of the mouth ciliated.—12. *Trichoda horrida.* Somewhat conical, fore-part rather broad and truncated, lower part obtuse, the whole covered with radiating bristles.—13. *Trichoda urinarium.* Egg-shaped, with a short hairy beak.—14. *Trichoda semiluna.* Semiorbicular, fore part hairy underneath.—15. *Trichoda trigona.* Convex, fore part ciliated, hind part apparently torn away.—16 *Trichoda tinea.* Clubbed, fore part hairy, hind part large.—17. *Trichoda nigra.* Oval, compressed, fore part broader and hairy.—18. *Trichoda pubes.* Egg-shaped, oblong, fore part depressed. — 19. *Trichoda floccus.* Membranaceous, fore-part rather conical; three small papillæ project from the base, which are set with hairs.

—20. *Trichoda sinuata.* Oblong, depressed, one margin hollow and hairy, the lower end obtuse.—21. *Trichoda præceps.* Membranaceous, somewhat lunated, protuberant in the middle, a row of hairs on the outside.—22. *Trichoda proteus.* Oval, the lower part obtuse, with a long neck, which it has the power of contracting or extending.—23. *Trichoda versatilis.* Oblong, hind part acute, with a neck that it can extend or contract at pleasure, under part of the extremity of the neck hairy.—24. *Trichoda gibba.* Oblong, with a hunch on the back, the belly hollowed out, the fore part ciliated, both ends obtuse.—25. *Trichoda fœta.* Oblong, with the back protuberant, the fore part ciliated, both ends obtuse.—26. *Trichoda patens.* Long, round, a long hole in the fore part, with the edges ciliated.—27. *Trichoda patula.* Inclining to oval, with a small tube at the fore part, the upper end covered with hairs.—28. *Trichoda foveata.* Oblong, rather broad, three little horns on the fore part, hinder part beardless.—29. *Trichoda striata.*—Oblong, one edge rather curved, and furnished with a row of hairs, both extremities obtuse.—30. *Trichoda uvula.* Rather flat and long, of equal size throughout, fore part hairy.—31. *Trichoda aurantia.* Sinuated, oval, fore part broad, apex hairy to the middle.—32. *Trichoda ignita.* Oval, apex rather acute, the under part furrowed, the furrows hairy.—33. *Trichoda prisma.* Oval, under part convex, upper part compressed into a kind of keel, the fore part small.—34. *Trichoda forceps.* Oval, with a pair of forceps at the fore part, with unequal hairy legs.—35. *Trichoda forfex.* Round and prominent, the fore part formed into a kind of forceps, and two small protuberances.—36. *Trichoda index.* Obovated, under part of the front of the margin hairy, apex formed by the fore part, projecting like the finger on a direction post.—37. *Trichoda* S. Striated, fore part ciliated, the extremities bent in opposite directions.—38. *Trichoda navicula.* Three cornered, fore part truncated and ciliated, hind part acute, and bent a little upwards.—39. *Trichoda succisa.* Flattened, oval, edge hairy, hinder part hollowed out so as to form two unequal legs.—40. *Trichoda sulcata.* Ovated, ventricose, apex acute, with a furrow at the abdomen, and both sides of it ciliated.—41. *Trichoda anas.* Long, the apex of the neck underneath hairy.—42. *Trichoda barbata.* Long, round, the under part from the apex to the middle hairy.—43. *Trichoda farcimen.* Long and thick, surrounded with small bristles.—44. *Trichoda crinita.* Long, round, everywhere ciliated on the upper part, and also on the under part as far as the middle.—45. *Trichoda angulus.* Angular, the apex hairy.—46. *Trichoda linita.* Oblong, with prominences at both extremities.—47. *Trichoda paxillus.* Linear, flat, fore part truncated and hairy, the hinder part obtuse.—48. *Trichoda vermicularis.* Long, cylindrical, with a short neck, the apex hairy.—49. *Trichoda melitæa.* Oblong, ciliated, with a dilatable neck, the apex globular, and ciliated, and a kind of peristaltic motion observable in it.—50. *Trichoda fimbriata.* Obovated, the apex hairy, the hinder part obliquely truncated and serrated.—51. *Trichoda camelus.* Thick, fore part hairy, with notches on the middle and each side.—52. *Trichoda augur.* Oblong, depressed, pellucid, and filled with molecules, vertex truncated, fore part forming a small beak, underneath are three feet, the hinder part is furnished with bristles.—53. *Trichoda pupa.* Hooded, front hairy, the tail inflected, at the lower part of the head is a large pellucid corpuscule.—54. *Trichoda lunaris.* Arched, round, the apex hairy, the tail bent.—55. *Trichoda bilunis.* Arched, flattened, the apex hairy, and two little bristles proceeding from the tail.—56. *Trichoda rattus.* Oblong, with a kind of keel, the fore part hairy, and a very long bristle proceeding from the hinder part.—57. *Trichoda tigris.* Long, and somewhat cylindrical, apex hairy, the tail divided into two long bristles.—58. *Trichoda pocillum.* Oblong, fore part truncated and hairy, the tail articulated, and divided into two bristles.—59. *Trichoda clavus.* Fore part round and hairy, hind part furnished with a sharp tail.—60. *Trichoda cornuta.* Upper part convex, under side plane, apex hairy, tail linear, and simple.—61. *Trichoda gallina.* Long, fore part sinuated, the front hairy, the tail formed of small hairs.—62. *Trichoda musculus.* Egg-shaped, fore part hairy, the tail projecting from the under part.—63. *Trichoda delphis.* Clubbed, front hairy, the tail small

and rather bent upwards.—64. *Trichoda delphinus.* Oblong, fore part hairy, the tail turned back and truncated.—65. *Trichoda clava.* Similar to the preceding in most respects.—66. *Trichoda cuniculus.* Oblong, fore-part hairy, hind part rather acute, filled with molecules and black vesicles.—67. *Trichoda felis.* Curved, large, the fore part small, hinder part gradually diminishing into a tail, under part set longitudinally with hairs.—68. *Trichoda piscis.* Oblong, fore-part hairy, hinder part terminating in a very slender tail.—69. *Trichoda larus.* Long, round, surrounded with hairs, the tail divided into two points.—70. *Trichoda longicauda.* Cylindrical, fore part truncated and surrounded with hairs, the tail long, furnished with two bristles, and having two joints.—71. *Trichoda fixa.* Spherical, the circumference set with hairs, and a small pedicle projecting from the body.—72. *Trichoda inquilinus.* Sheathed in a cylindrical transparent bag, having a little pedicle bent back within the bag.—73. *Trichoda ingenita.* Sheathed, the bag depressed, the base broadest.—74. *Trichoda innata.* Sheathed, in a cylindrical bag, with a pedicle passing through, and projecting beyond it.—75. *Trichoda transfuga.* Broad, fore part hairy, hinder part full of bristles, one side sinuated, the other pointed.—76. *Trichoda ciliata.* Ventricose, the hinder part covered with hair.—77. *Trichoda bulla.* Membranaceous, sides bent inwards, fore and hind parts furnished with hairs.—78. *Trichoda pellionella.* Cylindrical, fore-part hairy, hinder part furnished with bristles.—79. *Trichoda cyllidium.* Egg-shaped, the apex gaping, the base hairy.—80. *Trichoda cursor.* Oval, fore part hairy, hinder part furnished with straight and curved hairs in two fascicles.—81. *Trichoda pulex.* Egg-shaped, with an incision in the fore-part; the front and base hairy.—82. *Trichoda lynceus.* Nearly square, with a crooked beak, the mouth hairy.—83. *Trichoda erosa.* Orbicular, fore-part notched, one side furnished with hairs, the hinder part with bristles.—84. *Trichoda rostrata.* Depressed, mutable, yellow, with long cilia, and feet tapering to a point.—85. *Trichoda lagena.* Round, ventricose, with a long neck, and the lower end set with bristles.—86. *Trichoda charon.* Boat-shaped, with furrows, the fore and hind parts hairy.—87. *Trichoda cimex.* Oval, with a lucid margin, front and hind part hairy.—88. *Trichoda cicada.* Oval, with an obscure margin, fore part covered with hairs on the under side, and the hinder part beardless.

XIV. Kerona. An invisible worm with horns. "Animalcules furnished with hooks (*uncini*), bristles (*setæ*), or horn-like processes."

Plate 35, fig. 56. *Kerona pullaster.*—"The fore part, in addition to the cilia, is stated to have three setæ. The cilia at the opposite extremity are often separated; at other times they are collected in a cluster."

Kerona Species.

1. *Kerona rostellum.* Membranaceous, orbicular, with one projecting point, the upper surface covered with small horns.—2. *Kerona lyncaster.* Rather square, and its disc furnished with shining horns.—3. *Kerona histrio.* Oblong, membranaceous, with four or five black points in the fore part, which are continually changing their situation, thick set, with small globules in the middle, among which four larger ones are perceived, probably the eggs.—4. *Kerona cypris.* Egg-shaped, sinuated towards the hind part, the fore part hairy.—5. *Kerona haustrum.* Orbicular, with the horns in the middle, the fore part membranaceous and hairy, and several bristles in the hinder part.—6. *Kerona haustellum.* Differs from the preceding only in wanting the bristles in the hinder part.—7. *Kerona patella.* With a univalved shell, orbicular, crystalline; fore part somewhat notched.—8. *Kerona rannus.* Oval and rather flat, with one edge bent, the opposite one ciliated; the front furnished with horns, and the hind part with bristles.—9. *Kerona pullaster.* Described.—10. *Kerona mytillus.* Rather clubbed, broad at both extremities, clear and ciliated.—11. *Kerona lepus.* Egg-shaped, fore part hairy, the base furnished with bristles.—12. *Kerona silurus.* Oblong, the fore and hind parts hairy, the back ciliated.—13. *Kerona calvitium.* Rather broad, oblong, with glittering horns on the fore part.—14. *Kerona pustulata.* Oval, convex, one edge of the hinder part sinuated, both ends set with hairs, and several horns placed on the fore part.

XV. Himantopus. A pellucid, invisible, cirrated* worm.

Plate 35, fig. 58. *Himantopus larva.* "This is a very lively creature, swimming and turning in the water in a graceful and diverting manner, inflecting itself, as shown in the figure; the body gradually decreases towards the posterior, and at intervals several hairs appear disposed along it. The margin is fringed."

Himantopus Species.

1. *Himantopus acarus.* Round and prominent, the hinder part cirrated, the fore part sharp.—2. *Himantopus ludio.* Curled, the upper part hairy, the tail extended upwards.—3. *Himantopus sannio.* Crooked, the upper part ciliated, the under part hairy.—4. *Himantopus volutator.* Lunated, the fore-part hairy.—5. *Himantopus larva.* Described.—6. *Himantopus charon.* Boat-shaped, furrowed, the hollow part of the belly cirrated.—7. *Himantopus corona.* Semi-orbicular, flattened, both sides cirrated.

XVI. Vorticella. A small animal with a vascular cup; the mouth is ciliated, and capable of being contracted, the stem fixed.

The variety that may be observed in these minute animals confirms a principle, which, the more it is inquired into, the more it will be found to accord with the general operations in nature, namely, that there is always a pre-existent principle of life necessary to the organization both of animals and vegetables; that the alimentary and other particles which are added to, or apparently belong to them, produce nothing of themselves; they are incapable of forming the least fibre, but they are able to become constituent parts of one organical whole, together with the instruments whereby the former principle is manifested, and rendered capable of acting upon certain orders of creatures. The genus vorticella is very extensive. Müller enumerates no less than seventy-five species, and other observers have added to the number; in this, however, and in other similar instances, it would be better if examination were conducted with a view to lessen rather than increase the number of species, that is to say, if the several *stages of development* were carefully noted, when we believe many apparently distinct species would be found to be one and the same, in its various progressions towards maturity. The vorticella differ considerably in their organization, and Mr Pritchard has, in consequence, separated them into two divisions,—*V. polygastrica*, and *V. rotatoria*; the former of these includes the

* That is, furnished with a tuft, or lock, of hair.

animalcules whose alimentary structure consists of a number of sacs only, and the latter, those which have true alimentary canals and rotatory organs. Of the entire genus, Mr Pritchard remarks, "They are naked, contractile, and possess cilia circularly disposed near the mouth, producing a vortex in the water: in many of them they appear to rotate like a wheel; to account for which, various hypotheses have been invented. According to Dr Ehrenberg, this is occasioned by their peculiar disposition, and not from any difference of structure; for as with the vibrating cilia, the base of each is a bulb (similar to the species of the *Echines*), which by means of muscular fibres it can move in any direction, like a ball and socket joint. Thus each cilium in its revolution describes a cone, the apex of which is the bulb. Now if the cilia are arranged in a circle, and viewed laterally while in motion, the whole wheel will appear to revolve as each cilium passes; first, a little nearer the eye on this side of the cone, and then further off on the other side."

Plate 35, fig. 57. *Vorticella cyathini.*—"This animalcule is shown swimming freely: the edge of the bell is ciliated, though not exhibited in the sketch: it can attach itself by the stem, which it contracts spirally." Its polygastric structure is shown in the figure.

Plate 27, fig. 28. *Vorticella anastatica.*—These polypi form a group resembling a cluster, or more properly an open flower; this flower or cluster is supported by a stem, which is fixed by its lower extremity to some of the aquatic plants or extraneous bodies that are found in the water; the upper extremity forms itself into eight or nine lateral branches, perfectly similar to each other; these have also subordinate branches, whose collective form much resembles that of a leaf. Every one of these assemblages is composed of one principal branch or nerve, which makes with the main stem of the cluster an angle somewhat greater than a right one; from both sides of this nerve the smaller lateral branches proceed; these are shorter the nearer their origin is to the principal branch. At the extremity of the principal branch, and also of the lateral ones, there is a polype or vorticella. There are others on both sides of the lateral twigs, but at different distances from their extremity. These animalcules are all exceedingly small, and of a bell-like figure: near their mouth a quick motion may be discerned, though not with sufficient distinctness to convey an adequate idea of its cause; upon the branches of these clusters are round bodies, which will be more particularly described presently. Every cluster has eight or nine of these branches or leaves; they do not all proceed from the same point, but the points from whence they set out are not far asunder; each of these branches is bent a little inwards, so that all of them taken together form a kind of shallow cup. If the eye be placed right over the base of this cup, the appearance of the whole eight or nine branches is like unto that of a star, with so many rays proceeding from the centre. If the cluster be slightly touched, all the branches instantly fold up, and form a small round mass. The stem which supports the cluster contracts also, at the same time folding up like a workman's measuring rule, that consists of three or four joints. This extraordinary assemblage constitutes one organized whole, formed of a multitude of similar and also particular ones; a new species of society, in which all the individuals are members of each other in the strictest sense, and all participate in the same life.

A few days after one of the clusters is formed, small round bodies or bulbs may be perceived to protrude in several places from the body of the branch; these grow very fast, and arrive at their greatest growth in two or three days. The bulbs detach themselves from the branches out of which they spring, and go away, swimming till they can settle upon some substance which they meet with in the water, and to which they fix themselves by a short pedicle; the bulbs are then round, only a little flatted on the under side, the pedicle continues to lengthen gradually for about twenty-four hours, during the same time the bulbs also change their figure, and become nearly oval. There are in a cluster but few of these bulbs, compared with the number of the vorticellæ, neither do all the bulbs come out at the same time. The bulb then divides lengthways into two smaller ones, (see *figure*) but which are still much larger than the vorticellæ themselves. It is not long before these are separated like the first, and thus form four bulbs on the same stalk; these again divide themselves, and form eight; which again subdivide, and consequently make sixteen. They are all connected with the stalk by a proper pedicle, but they are not all of an equal size; the largest continue to divide and the smallest begin to open, and take the bell-formed shape. Trembley observed from one round bulb, in about twenty-four hours, by repeated divisions, one hundred and ten vorticellæ to be formed.

Vorticella digitalis. This species of the vorticella is very scarce, it seems only to have been seen by Rosel, who found it on the monoculus quadricornis, (see *figure*) till it was discovered in 1784, by Müller, who had sought for it several years before, but in vain. The body is cylindrical, crystalline, and appears almost empty; it has three pellucid points disposed lengthways, the apex is truncated in an oblique direction, the margin bent back. The

upper part contracts itself, and the margin then assumes a conical shape, with a convex surface; there are in general but few branches from the principal stem, and these are short



and thick. It excites an undulatory motion, but neither hairs, nor rotatory motion, have been discovered. The figure represents the vorticella adhering to the monoculus quadricornis.

Vorticella convallaria. These vorticellæ, or bell-animals, as they are termed by Baker,



are generally found adhering to some substance in the water; they are represented here as found by Rosel, fixed to a curious *cornu ammonis*, with points projecting from the back. To the naked eye they appear only as so many little white points, but under the microscope, as little bells, agitating the water to a considerable distance. The stems of these have a particular motion, they draw themselves up and shorten all at once, taking the form of a spiral wire or screw; in a moment after they again extend themselves. Many of them may be seen at times adhering to each other by their tails; the cilia are disposed round the mouth, and require a good defining power to exhibit them satisfactorily. On reference to the figure, it will be perceived that some of the animalcules differ in appearance from others; those which are nearly circular are in a state of inactivity; others, assuming an oval form, and beginning to open, are in the act of stretching themselves out to take their prey; and such as have taken the perfect cup-like shape, are fully extended, with their cilia in action, collecting food. One is drawn on a considerably enlarged scale, to exhibit more clearly the *styli* and cilia.

Vorticella Species.

1. *Vorticella cineta.* In the form of a trapezium, of a blackish green colour, and opaque.—2. *Vorticella sphæroida.* Globose, uniform, and opaque.—3. *Vorticella viridis.* Cylindrical, uniform, green, and opaque.—4. *Vorticella lunifera.* Green, the hinder part luminated, with a point in the middle projecting from the edge.—5. *Vorticella bursata.* Green, the aperture truncated, with a central papillary projection.—6. *Vorticella varia.* Cylindrical, truncated, opaque, of a blackish colour, the fore part ciliated.—7. *Vorticella sputarium.* Round and prominent, with an orbicular aperture, and long hairs radiating as from a centre.—8. *Vorticella nigra.* Black, and top-shaped.—9. *Vorticella multiformis.* Green, opaque, variable, with vesicles scattered about the body.—10. *Vorticella polymorpha.* Many-shaped, green, opaque.—11. *Vorticella cucullus.* Long, round, the aperture or mouth obliquely truncated.—12. *Vorticella utriculata.* Green, the belly round and prominent, capable of being lengthened or shortened; the fore-part truncated, much in the shape of a common water-bottle; the neck is sometimes very long, at others, very short, and filled with green molecules.—13. *Vorticella ocreata,* Nearly of a cubical figure, the under part bent in an obtuse angle.—14. *Vorticella valga.* Cubical, the lower part divaricated.—15. *Vorticella papillaris.* Big-bellied, the fore-part truncated, with a papillary tail, and a splendid papillary excrescence on the side.—16. *Vorticella sacculus.* Cylindrical, the aperture broad and flat, the edge turned down.—17. *Vorticella cirrata.* Big-bellied, the aperture sinuated, two tufts of hair on each side of the belly.—18. *Vorticella nasuta.* Cylindrical, with a prominent point in the middle of the cup.—19. *Vorticella stellina.* Orbicular, with a molecular disc, and ciliated margin.—20. *Vorticella discina.* Orbicular, the edge ciliated, with a kind of convex handle on the under side.—21. *Vorticella scyphina.* Bowl-shaped, crystalline, with an opaque spherule in the middle.—22. *Vorticella albina.* The fore-part cylindrical, the hinder part tapering and ending nearly in a point.—23. *Vorticella fritillina.* Empty, cylindrical, the apex truncated.—24. *Vorticella truncatella.* Cylindrical, stuffed or filled, the apex truncated, with very short cilia.—25. *Vortacella limacina.* Cylindrical, truncated with two pair of cilia.—26. *Vorticella fraxinina.* Gregarious, cylindrical, obliquely truncated, with two pair of cilia, and a fissure or notch at the upper edge.—27. *Vorticella crategaria.* Compound, with globous naked florets, two tentacula, and a branched stem.—28. *Vorticella hamata.* Purse-formed, the edge of its aperture or mouth set with rigid points.—29. *Vorticella crateriformis.* Approaching to a square figure, with fascicles of cilia even at the hinder part.—30. *Vorticella canaliculata.* Dilated, pellucid, with an incision in the side.—31. *Vorticella versatilis.* Long, spear-formed, but often changing into a pitcher-like form.—32. *Vorticella ampulla.* Contained in a pellucid bottle-shaped bag, the head divided into two lobes.—33. *Vorticella folliculata.* Oblong, in a bright cylindrical bag.—34. *Vorticella larva.* Cylindrical, the aperture crescent-shaped, two small thorny points projecting from the hinder part.—35. *Vorticella sacculata.* Like an inverted cone, the aperture crescent-shaped, lower part of the trunk notched, the tail biphyllous.—36. *Vorticella aurita.* Cylindrical and big-bellied, the aperture destitute of hairs, both sides of it are furnished with rotatory cilia, tail biphyllous.—37. *Vorticella tremula.* Conical shape,

mouth divided into two parts and set with small spines, a point projecting from the tail.—38. *Vorticella serita.* Somewhat cone-shaped, the aperture set with spines, the tail short and divided into two points.—39. *Vorticella lacinulata.* Like an inverted cone, the aperture lobated, the tail small and furnished with two bristles.—40. *Vorticella constricta.* Elliptical, ventricose, the mouth undivided, the tail annulated and forked.—41. *Vorticella togata.* Square, the aperture not divided, the tail consisting of two long spines, which occasionally unite and appear as one.—42. *Vorticella longiseta.* Long, flat, the tail formed of two very long bristles.—43. *Vorticella rotatoria.* Cylindrical, with a little organ projecting from the neck, and a long tail furnished with four points.—44. *Vorticella furcata.* Cylindrical, the aperture undivided, the tail rather long, and divided into two parts.—45. *Vorticella catulus.* Cylindrical, the aperture plain, the tail short, bent back, and divided into two points.—46. *Vorticella canicula.* Cylindrical, the aperture plain, with a short articulated tail divided into two pointed parts.—47. *Vorticella felis.* Cylindrical, beardless, with the tail terminating in two long spines.—48. *Vorticella stentorea.* Long-tailed, trumpet-shaped, the arms furnished with rows of short hairs.—49. *Vorticella socialis.* Bearded, thick, and wrinkled.—50. *Vorticella flosculosa.* An aggregated tail, oval-shaped, with a dilated pellucid disc.—51. *Vorticella citrina.* Simple, many-shaped, with an orifice admitting of contraction, and an equally sized foot-stalk.—52. *Vorticella piriformis.* Simple, oval, with a very short retractile foot, which it can draw within itself.—53. *Vorticella tuberosa.* Simple, the upper part broad, the under part small, with two projections at the anterior end, furnished with a number of fibrilla.—54. *Vorticella ringens.* Simple, somewhat oval-shaped, with a small pedicle, and an orifice which it contracts or dilates.—55. *Vorticella inclinans.* Simple, bent, with a short pedicle, and small retractile head.—56. *Vorticella vaginata.* Simple, erect, shaped like a truncated egg, the pedicle contained in a sheath.—57. *Vorticella globularia.* Simple, spherical, with a twisted pedicle.—58. *Vorticella lunaris.* Simple, hemispherical, with a twisted pedicle.—59. *Vorticella convallaria.* Described.—60. *Vorticella nutans.* Simple, with a twisted turbinated pedicle.—61. *Vorticella nebulifera.* Simple, egg-shaped, the pedicle bent back.—62. *Vorticella annularis.* Simple, truncated, with a pedicle twisted at the end.—63. *Vorticella acinosa.* Compound, with ciliated globous naked florets, and an umbellated stem.—64. *Vorticella fasciculata.* Simple, green, bell-shaped, the margin or edge turned back, the pedicle twisted.—65. *Vorticella hians.* The head resembling a citron, the apex truncated, the base narrow; a gaping cleft is observable descending from the apex to one-third of the body.—66. *Vorticella bellis.* Simple, hemispherical, with a margin, which it can contract at pleasure.—67. *Vorticella gemella.* Simple, spherical, with a double head.—68. *Vorticella pyraria.* Compound, with beardless oval florets, two double arms, the stem branched.—69. *Vorticella anastatica.* Described.—70. *Vorticella digitalis.* Described.—71. *Vorticella polypina.* Compound, oval truncated, with a bending, branching stalk.—72. *Vorticella racemosa.* Compound, rigid pedicle, with small branched long feet.—73. *Vorticella cyathini.* Described.

XVII. Brachionus. A worm capable of contracting, covered with a shell, and furnished with rotatory cilia.

Plate 35, fig. 53. *Brachionus passus.*—"A curious little creature, with two long bristles in front, like the antennæ of an insect."

Plate 27, fig. 23. *Brachionus Bakeri.*—The general characteristics of this creature are as follows:—the shell ventricose, four teeth at the apex, two horns at the base, and a long tail terminating in two short points. From each side of the shell there is a curved projection, inclining towards the tail. The upper part of the shell has in general four longer spiculæ, and two shorter ones. From the head, two arms or branches are frequently extended; the circular end of each is furnished with a tuft of little hairs, which sometimes move in a vibratory manner, at other times have a rotatory motion. The eggs are either affixed to the tail, or the curved part of the shell; they have from one to five hanging from them.

Brachionus Species.

1. *Brachionus striatus.* Univalve, the shell oval and striated, six notches or teeth round the upper edge, the base whole or even, without a tail.—2. *Brachionus squamula.* Univalve, shell orbicular, the apex, truncated, and having four teeth, the base smooth, no tail.—3. *Brachionus pala.* Univalve, with an oblong excavated shell, four long teeth at the apex, the base smooth, no tail, the colour yellow.—4. *Brachionus bipalium.* Univalve, the shell oblong and inflected, ten teeth at the apex, the base smooth, and a spurious tail.—5. *Brachionus patina.* Univalve, shell orbicular, the edges regular, and having a long beardless tail.—6. *Brachionus clypeatus.* Univalve, the shell oblong, the apex notched, the base smooth, and the tail naked.—7. *Brachionus lamellaris.* Univalve, the shell extending considerably beyond the body; the base divided into three small horns, with two hairs at the end of the tail.—8. *Brachionus patella.* Univalve oval shell, two teeth at the apex, the base notched, two bristles at the tail.—9. *Brachionus bractea.* Univalve, shell rather orbicular, lunated apex, smooth base, and the tail furnished with two spines.—10. *Brachionus plicatilis.* Univalve, with an oblong shell, the apex hairy, and the base notched.—11. *Brachionus ovalis.* Bivalve, with a flattened shell, the apex notched, a hollow part at the base, the tail formed of two tufts of hairs.—12. *Brachionus tripos.* Bivalve, the apex of the shell beardless, three horns at the base, and double tail.—13. *Brachionus dentatus.* Bivalve, with an arched shell, the apex and the base are both toothed, and the tail formed of two spines.—14. *Brachionus mucronatus.* Bivalve, something of a square form; the apex and base pointed; the tail consisting of two spines.—15. *Brachionus uncinatus.* Bivalve, with an oval shell, the apex even, the base pointed, two thick bristles for the tail.—16. *Brachionus cirratus.* Ventricose, somewhat pellucid, the head conical, with a bundle of hairs on both sides; it has also a rotatory organ.—17. *Brachionus passus.* Described.—18. *Brachionus quadratus.* Capsular, in a quadrangular shell, with two small teeth at the apex, two horns proceeding from the base, and no tail.—19. *Brachionus impressus.* Capsular, the shell quadrangular, a smooth undivided apex, obtuse base, notched margin, and a flexuous tail.—20. *Brachionus urceolaris.* Single, with a short tail, and toothed mouth.—21. *Brachionus Bakeri.* Described.—22. *Brachionus patulus.* Capsular, shell ventricose, eight teeth at the apex, the base lunated or hollowed into the form of a crescent, and furnished with four horns; the tail short, with two small points at the end.

In closing this brief account of the Infusoria, we would again call the attention of microscopists to the propriety of merging *apparently* special differences into one individual, by attentively noting the successive changes which each creature undergoes. From our own observation we are convinced that nothing more is required than a good instrument, extensive leisure, and considerable patience, to enable the philosophical inquirer to simplify the Infusorial arrangement: that this is a desirable object for attainment none will deny, except those who are so enamoured of systematic complexity, that they delight in nothing

so much as in stringing together hard names, and in weaving learned labyrinths which shall be "caviare to the general."

In our first chapter we remarked that molecular activity closely resembles the vitality of the infusorial monads, and stated our intention of returning to the subject. We shall in this place offer only a few incidental observations. So far as the mere activity is concerned, the movements of the monads and molecules are apparently identical; there may, notwithstanding, on a careful examination, be discovered an evident *voluntary* action on the part of the monads, which cannot be detected in the molecules; these latter obviously act upon each other, the former act independently of each other. All supposed identity between molecular and monadic motion, is, however, we conceive, entirely overthrown by the recent discovery of the polygastric structure of infusoria. The monads, it is ascertained, have polygastric sacs similar in principle to those of the larger animalcules, regarding whose animal vitality there can be no question; consequently we have a right to infer, from analogy, that the monads, though placed at the extreme limit on the descending scale of animality, are not mere active atoms, but really organized animal bodies; and indeed it is tolerably well ascertained that these monads pass into other forms and are ultimately developed in the larger and less equivocal animalcular existences.

CHAP. III.

SPERMATIC ANIMALCULES.

Towards the close of the seventeenth century the existence of seminal animalcules was discovered and made known to the world by Leeuwenhoeck and Hartsoeker, each of whom claimed the honour of being the first observer. The former micrographer, if he did not originate the discovery, at least explained and illustrated it to a much greater extent than his contemporary; and he has consequently been considered as the leading authority on the subject. The hypotheses and controversies which arose out of the inquiries regarding spermatic animals, are interesting to the natural historian; and though, in a popular work, the subject must be approached with caution, it is still desirable that some general information should be given concerning these vital germs, whose existence is undeniable, though their relation to the mature animal has not even yet been ascertained.

Before the discovery of animalcules in the *semen masculinum*, the egg system, as it was termed, obtained universal consent. It was asserted that the female ovaria contained eggs, waiting only till a principle of life was communicated to them by the other sex, when the previously formed fœtus would burst through these receptacles and claim their birth. When the existence of spermatic animals was announced, a system entirely opposite in principle was earnestly contended for by many of the leading philosophers of the day. The new hypothesis considered the seminal animal to be identical with the mature fœtus, and that it needed only for its perfect developement, a suitable nidus, which was provided in the uterus of the female. The advocates of each system contended strenuously for its support; but the data in either case were insufficient to decide the problem of generation, and both parties continued to argue hypothetically, advancing with every fresh argument still nearer to the climax of absurdity. At the present day we have no certain knowledge concerning the mysterious process by which the succession of animated creatures is secured, and the intent of the spermatic animals is still matter of perplexity. These vital germs do, however, exist in the seminal fluids of all animals, from the largest to the least; and it is to their mere existence that our further remarks will principally be directed.

Mr Leeuwenhoeck observed in the semen of the human species, not less than ten thousand living creatures, contained in a portion of the fluid equal in surface to a grain of sand. "Their size was smaller than the red globules of the blood, and even less than the millionth part of a grain of sand. Their bodies were roundish, somewhat flat before, but ending sharp behind, with tails exceedingly transparent, five or six times longer, and about five times more slender than their bodies. They moved themselves along by the violent agitation of their tails, in various bendings, after the manner that eels and serpents swim: and sometimes their tails were moved thus eight or ten times in getting forwards the diameter of a hair." Their shape may be more popularly described as being very nearly that of the tadpole. The seminal animalcules of all living creatures, that have been examined, bear strong resemblance to each other; the size likewise does not vary according to the disproportion of bulk in different animals, and hence they are readily discovered in the semen of birds, fishes, and insects.

"Upon viewing the milt, or *semen masculinum*, of a living cod-fish, such numbers of animalcules were found therein, that at least ten thousand of them were supposed to exist in the quantity of a grain of sand. Whence Mr Leeuwenhoeck argues that the milt of that single cod-fish contained more living

animalcules than there are people alive upon the face of the whole earth at one and the same time. To find the comparative size of these creatures, he placed a hair of his head near them, which hair through his microscope appeared an inch in breadth ; and he was satisfied that at least sixty such animalcules could lie within that diameter, whence, their bodies being spherical, it must follow, that two hundred and sixteen thousand of them are but equal to a globe whose diameter is no more than the breadth of such hair."

Mr Leeuwenhoeck assures us that he found a fluid in male spiders, which was undoubtedly their semen, and he therein discovered prodigious multitudes of animalcules so extremely minute, that many millions of them would not equal the size of a grain of millet. " He found them likewise in the semen of the dormouse, in oysters, in silk-worms, in the *libella minima*, or small dragon fly, in the common fly, in the flea, in gnats, and in several other insects." It has been objected to these discoveries, that no organs have been detected in insects for the secretion of a seminal fluid, and that Leeuwenhoeck must consequently have suffered his enthusiasm to deceive him into a belief that he saw what had no existence. Whether, however, secretory organs may be detected or not, no curious inquirer need remain in doubt as to the fact of animalcules existing in insect bodies ; and from the circumstances under which they are obtained, and their striking similarity, both in figure and activity, to the seminal animals of larger creatures, the inference is fairly drawn from analogy that their character and uses are the same.

Buffon asserts that what have been called spermatic animals are not creatures really possessing life, but something proper to compose a living creature, distinguishing them by the name of *organic particles*, and that the moving bodies which are to be found in the infusions either of animal or vegetable substance, are of the same nature. But to this we may add, that all those who have examined the subject with accuracy and attention, concur in the belief that Buffon, and others who adopted his views, had deceived themselves by inaccurate experiments, and that Buffon himself had not even seen the spermatic animals he supposed himself to be describing. We do not altogether adopt this opinion : we are inclined to think that Buffon had occasionally seen the seminal animalcules, but it was through the medium of glasses ill-adapted for their development, that is to say, he observed them under the confused powers of a compound microscope of the old construction, the most unsuitable instrument that could possibly be employed in such researches. It is very evident that he saw nothing distinctly and satisfactorily, or he would not have confounded the spermatic animals with the gelatine masses that are occasionally found in the semen. He says,—" We do not always see, in the human semen, the filaments (tails) I have mentioned : for this purpose, the liquor must be examined the moment it is extracted from the body ; and even then they do not uniformly appear. When the liquor is too thick, it presents nothing but large globules, which may be distinguished with a common lens. When examined with the microscope they have the appearance of small oranges ; they are very opaque and one of them occupies the whole field of the microscope." He proceeds to say that after examining these globules, he diluted the semen and found nothing like life or motion therein. The sum of all this is, that the semen here alluded to was either unhealthy and contained no animalcules, or had been so long removed from the body, that the vital germs had ceased to exist, in which case they would blend with the liquor and be indistinguishable ; for it is a fact familiar to every observer of these creatures, that when their existence is drawing to a close they collect together in large groups, and when dead form nearly a homogeneous mass.

There is a strange degree of confusion throughout Buffon's experiments and observations on the spermatic animals, which can only be accounted for by assuming that his optical resources were inadequate, and that whilst he saw nothing with sufficient distinctness to furnish data for an accurate judgment, he was willing to bend all the phenomena he saw to the purpose of a preconceived and favourite theory. For instance, he speaks of the animalcules as being attached by their tails to some foreign substance, as evidently striving to rid themselves of the tails, and as actually accomplishing this and becoming in consequence more active and lively. The absurdity of these assertions is strikingly shown by observation with the improved microscopic powers of the present day. These animals are now readily seen in all their extent, and in all their movements ; the tail is not, as Buffon says, a mere filament, but an absolute elongation of the body, gradually tapering and terminating in the finest point imaginable ; and the animals evidently could not, if so disposed, free themselves from this appendage. Their motions are, as already noticed, precisely that of an eel or a serpent in water ; and if at any time they *appear* to lose their tails, it is when their motions are about to cease, when they are dying, at which time they not unfrequently coil themselves into a circular mass.

Mr Needham, who was contemporary with Buffon, endeavoured to prove that all seminal animalcules, so called, in place of being really animated beings, are only prodigiously small machines. He will be best understood in his own words, when describing the milt of the Calmar, a species of cuttle-fish, whose seminal animals resemble spiral springs inclosed in a transparent case. "When the small machines," he says, "have come to maturity, several of them act as soon as they are exposed to the air. Most of them, however, may be commodiously viewed by the microscope before their action commences; and even before they act, it is necessary to moisten with a drop of water the superior extremity of the external case, which then begins to expand, while the two slender ligaments that issue out of the case are twisted and contorted in different ways. At the same time, the screw rises slowly, and the spirals at its superior end approach each other, and act against the top of the case, those which are lower seeming to be continually followed by others that issue from the piston; *I say, that they seem to follow; because I believe it to be only a deception produced by the motion of the screw.*" We need not pursue his remarks further, as they would be unintelligible without a diagram. We may, however, add Buffon's remark upon his theory.

Mr Needham concludes that it is natural to imagine that the total action of this machine is occasioned by the spring of the screw. But unfortunately, he proves by several experiments, that *the screw is acted upon by a power residing in the spongy part:* as soon as the screw is separated from the rest of the machine, it ceases to act, and loses all motion." What then is the sum of Mr Needham's hypothesis? Simply this: that spermatic animals, like all other living creatures, considered apart from the vital principle, are machines; but that these machines have *within* them a motive and active force; or in other words, they are endued with vitality, by which they move and act independently of any external agent. The question of vitality, is not perilled by the statement that "even before they act, it is necessary to moisten the upper extremity." Sustenance is necessary to all animals; the organs cannot act without a material on which to act, and the inactivity of the organs is death or a suspension of vitality. The fact of apparent death, and repeated revivescence, at the pleasure of the experimentalist, is strikingly witnessed in the case of some Infusoria, that die when the moisture in which they exist evaporates, and revive again so soon as new fluid is applied to them. This phenomenon, it will also be remembered, is observable in a class of animalcules exhibiting a *peristaltic action*, and consequently identified with animal existences.

Buffon, as an additional argument against the actual vitality of seminal and other animalcules, instances the fact of minute active particles being found in various substances and under circumstances that totally preclude a living principle. These are nothing more than what in the present day are designated the active molecules of matter, those simple inorganized particles of every description of bodies which exhibit a singular and uniform activity, arising, as we have previously supposed, from their mutual action upon each other. And though when the seminal animals are crowded together, their motions appear to be almost the same with those of the molecules, we no sooner thin the multitudes of the former, and spread them over a larger space, than we distinctly perceive that their motions are independent of external causes, and are directed by a principle of volition resident in the individuals.

Having stated and replied to the principal objections that have been urged against the vitality of seminal animals, we shall briefly advert to the wild speculations which arose out of their discovery. Leeuwenhoeck and many others strenuously contended that these animalcules were really miniatures of human kind; "but what is still more amazing, Dalenpatius saw one of these animals break through its coat or covering: it was then no more an animalcule, but a real human body, in which he easily distinguished the two arms and legs, the breast and the head."! The doctrine of *evolution*, as it is termed, seemed to be established by the discovery of the spermatic animalcules: "according to it, all animals have existed from the first creation as *perfect, preformed germs*, within their *ancestors*, the succeeding generations being lodged in the preceding ones like nests of boxes, and progressively developed." There is a point where human reasoning must pause: in the present case, we must be content to know that the prolific animal fluid contains myriads of living creatures whose purpose in the generative economy still remains unknown. What new discoveries may be made concerning them with the vastly improved instruments now in use, it is impossible to say; we may however, venture an opinion that philosophic inquiry cannot be better employed than in eliciting by all the legitimate means which art and science progressively supply, more and more of the mysteries and wonders connected with the continual succession of animated beings.

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SPONGE.—This well-known production of the sea has been in use from the earliest times, and naturalists were long embarrassed whether to give it a place in the animal or vegetable kingdom. Most authorities now place it in the lowest scale of animal life. There are fifty different kinds of sponge. Sponges are found plentifully in the Mediterranean and other seas of warm climates, but diminish in number and deteriorate in quality as they approach cold latitudes. They adhere to rocks in places the least exposed to the action of the currents and waves, and below low water mark. The best sponges come from the Archipelago, where they abound near many of the islands, whose inhabitants subsist entirely by the sponge fishery. At the Cyclades, sponge-diving forms the chief employment of the population. The sea is at all times very clear, and experienced divers can distinguish from the surface the points to which the sponge is attached below, when an unpractised eye could but dimly discern the bottom. Each boat is furnished with a large stone attached to a rope, and this the diver seizes in his hand, on plunging head foremost from the stern. He does this in order to increase the velocity of the descent; thus economizing his stock of breath, as well as to facilitate his ascent, when exhausted at the bottom, being then quickly hauled up by his companions. Few men can remain longer than about two minutes below; and, as the process of detaching the sponge is very tedious, three, and sometimes four divers descend successively to secure a particularly fine specimen. The best sponge is that which is the palest and lightest, has small holes and is soft to the touch. Of old, sponge was regarded as a cure for a long list of maladies. Burned sponge still holds a prominent place among the materials of medici[illegible]

THE PEON, THE RAT, AND THE SNAKE.—One of those singular escapes occurred a few days back, for narrating which old Indians get accused of drawing the most formidable long-bows, when they settle down on their pensions in that portion of the metropolis dedicated to their retirement under the appropriate name of Asia Minor. This, however, is a fact, as doubtless is many a similar story which has made people stare and shake their heads. A peon in the Tannah near the College Bridge, observed a rat run across the floor. He stooped to look after it, having his turban off and his back hair loose. While in this position he suddenly felt as though some one were tugging him back by his hair. He put his hand up, and to his horror found there was a large cobra on his back, struggling to free its teeth from his hair, in which they had got entangled. Probably the reptile had also observed the rat, and had dropped from the roof, imbued with as keen a love of hunting as the peon himself. Be that as it may, the snake ultimately succeeded in getting loose, and escaped to a hole without inflicting any injury on the man. By the order of the chief magistrate the place was pulled down the next day, and there, sure enough, was the snake, with the rat in his stomach half-digested.—*Delhi Gazette.*

WESTERN GIANTS IN THEIR SLUMBER.—The Burlington (Iowa) *State Gazette* says that while some workmen were engaged in excavating for the cellar of Gov. Grimes' new building, on the corner of Main and Valley streets, they came upon an arched vault some ten feet square, which, on being opened, was found to contain eight human skeletons of gigantic proportions. The walls of the vault were about fourteen inches thick, well laid up with cement, or indestructible mortar. The vault is about six feet deep from the base to the arch. The skeletons are in a good state of preservation, and we venture to say are the largest human remains ever found, being a little over eight feet long.

Who are the Longest Lived?

There appears to be a wide difference of opinion between some of our most intelligent and respectable cotemporaries in regard to the subject, who are the longest lived of nations? We copy some of their remarks:

The Americans are the longest lived of people notwithstanding all the humbug about the great age to which the English live, their superior stamina, etc. And the longest lived of Americans are to be found here, in this very New England, although such a mess of stuff is said about the Yankees working themselves to death, being half-starved and depriving themselves of the enjoyments of life thus tending to abbreviate it; and despite the arguments which are based upon the changeability of the climate, the east wind, and all that. These are but windy arguments. Statistics tell a different story.—*Boston Evening Ledger.*

Americans are not the longest lived people, and we much mistake if we are destined to be a long lived nation, even! The Irish, of whom the writer claims to be a descendant, are the longest lived;—but we don't know whether to attribute it to their climate or the simple diet to which the general poverty confines them.—*Charleston (S. C.) Mercury.*

You should have confined yourself, brother *Mercury*, before you delivered that sapient opinion.—Humboldt has placed it beyond a doubt that the mountaineers of Peru can contest the palm with death longer than anybody else.—*New Orleans Picayune.*

That's a lie. Humboldt says no such thing anywhere.—*New York Evangelist.* [Tut, tut, tut.—What language for an "evangelist" to use! Can there be any wonder that naughty boys curse and swear, when they have such examples from such quarters!—*Ed. Life Illustrated*]

Keep cool, gentlemen, or none of you will be long-lived. We believe the greatest age of man to be obtained by the Hindostanees, and refer the curious in such matters to Buffon's interesting account of the people.—*New York Herald.*

Our American friends are having a dispute as to what people present the most numerous instances of advanced age in man. Cold regions we believe to be the most favorable to the prolongation of life but we have nothing to disprove that the Dutch live longer than any other race—too long for their own good, perhaps.—*London Times.*

The London *Times* has been having a fling at the Dutch, referring to the great age to which some of the Mynheers attain, though nothing is mentioned about old Rip Van Winkle. The *Times* is famous for wholesale slurs upon nations, though just now it has not a word to say against its dear neighbor France. If we were asked who lived the "longest of all people, we should say the Patagonians, for numbers of the stand full eight feet high—*Boston Post.*

The Boston *Post* thinks the Patagonians live the longest of all mankind. That may be; but it is certain that the inhabitants of the Himmaleh mountains live the highest.—*Boston Herald.*

That may be, too, neighbor; but a still sure thing is, whether the Yankees live the [illegible] not, they are destined [illegible]

1856

MAN VS. BEAR.—On Saturday last, Sept. 6th, says the Stockton *Argus*, Mr. F. H. Ayres, living on the San Joaquin river, went in pursuit of a bear that had been committing depredations on his swine. Coming up with the animal, he discharged the contents of both barrels of his gun into his body. This incensed, without disabling the bear, causing him to turn upon his assailant, when, with one stroke of his paw, he tore away a portion of his thigh, and, seizing his head in his mouth, crushed it in a fearful manner, breaking in the bones of the forehead and nose, and laying bare a portion of the brain. The brute then left him. He was traced some distance by the blood from the gunshot wounds inflicted upon him, but was not overtaken. Dr. Ryer dressed the wounds of Mr. Ayres, which are of such a severe character as leaves little chance of his recovery.

We never could see the propriety of persons acquainted with the fierce and dangerous nature of the grizzly bear, going out to attack him in the manner Mr. Ayres seems to have done. To this reckless practice, nearly every accident of this class may be traced. This animal is naturally pacific in his disposition, rarely ever attacking man unless provoked by an assault, and even then, as a general thing, he appears to think discretion the better part of valor; retreating, in most cases, rather than engage in a fight. But, when wounded, or closely beset, he never fails to turn and defend himself, and generally with spirit and effect.

He has but a few points fatally vulnerable, even to the rifle ball; hence, the hunter cannot always calculate upon killing, even when he is fairly within range. The heart and the brain are, of course, always vital points when reached by the leaden missile. But it often happens that the bullet, though well directed, strikes the bony covering which protects these parts, at an angle that turns it from its course, causing it to produce no further injury than just sufficient to irritate the object of attack, and bring him upon the now defenceless hunter. It is in this manner that many have heretofore lost their lives, or been terribly crushed and maimed in their encounters with this usually peaceful friend, but dangerous foe. Bruin is by no means a denizen of exemplary habits. He is a night-prowler, lax and unscrupulous in his notions of honesty; a picker up of loose things about a barn yard too, like a city official, preying upon pigs, poultry and offal, left in exposed positions.

We cannot deny that, yet we can hardly recall an instance of deadly conflict between him and his human antagonist, in which he was decidedly the aggressor. In view of his predatory, pilfering, shoulder-striking practices, we don't object to his being attacked and driven from civilized society, but would admonish those who undertake the job, to make ample preparation for defense, as well as attack. Don't go alone, depending on a simple shot or two, but in numbers, well armed, not only with rifles, but also a heavy knife for close quarters, should it come to that. Dogs are often of great service in attacking the grizzly, by worrying and keeping him at bay, thereby giving the hunter a better opportunity to approach and secure a good shot.

Wonders of the Microscope.

The meaning of *Animalculæ* is animals whose figures cannot be discerned without the aid of the magnifying glass. The recent astonishing discoveries of Ehrenberg, a Prussian naturalist, have given a new aspect to this department of animal nature, even in a geological point of view. He has described seven hundred and twenty-two living species which swarm almost everywhere, even in the fluids of living and healthy animals in countless numbers. Formerly they were thought to be the most simple of all animals in their organization; to be in fact little more than mere particles of matter endowed with vitality; but he has discovered in them mouths, teeth stomach muscles, nerves, glands, eyes and organs of reproduction. Some of the smallest animalculæ are not more than the twenty-four thousandth of an inch in diameter, and the thickness of the skin of their stomachs not more than the fifty millionth part of an inch. In their mode of reproductions they produce their young alive, also by eggs, and by buds or gems. An individual of the Hydatina senta increased in ten days one million; on the eleventh day to four million, and on the twelfth day to sixteen million. In another case Ehrenberg says that one individual is capable of becoming in fours days one hundred and seventy billions! Leuwenhoeck calculated that one billion animalculæ, such as occur in common water, would not altogether make a mess so large as a grain of sand Ehrenberg estimates that five hundred million of them do actually sometimes exist in a single drop of water. In the Alps there is sometimes found a snow of red color; and it has been recently ascertained by M. Seutterworth that the coloring matter is composed chiefly of sutusoria, with some plants of the tribe of Algae. And what is most singular is, that when the snow had been melted for a short time, so as to become a little warmer than the freezing point, the animals die, because they cannot endure so much heat. A specimen of meteoric paper which fell from the sky in Courland in 1686, has been examined by Ehrenberg, and found to consist, like the red snow, of *Confrva* and *Infusoria*. Of the latter he found twenty-nine species. Surprising as these facts are, it will perhaps seem still more incredible that the skeletons of these animals should be found in a fossil state, and actually constitute nearly the whole mass of soils and rocks, several feet in thickness, and extending over areas of many acres. Yet this, too, has been ascertained by the same acute Prussian naturalist. 1856

The Golden Era, having a much larger circulation than any other journal in this city, has been awarded by Postmaster Weller the publication of the uncalled for letters in the San Francisco Post Office for 1856.

FIRST EDITION.

SUNDAY MORNING, AUGUST 17, 1856.

A Snake Story---A Live Snake in a Live Man.

A gentleman, whose name we did not learn, arrived in this city from Bird's Hill, on Monday last, for the purpose of procuring surgical advice in relation to the possibility of removing from the stomach a large snake, which has inhabited that locality for the past fifteen years. Exactly at what time the reptile was taken into the stomach, the sufferer is not aware. He first felt its presence in the vicinity of the kidneys many years ago; but the pains experienced, although sometimes acute and troublesome, occasioned no alarm until about two years since, when one day feeling quite unwell, he placed his hands upon his bowels and distinctly felt the snake crawling within him. Since then it has grown enormously, and has attained a length of at least fifteen inches, and a size around the middle of five or six inches. It proportions can be pretty accurately ascertained, as its entire shape is fearfully obvious to the touch. It is quite active, and possesses an insatiable appetite, judging from the amount of food and water consumed by the sufferer, who is continually parched with thirst, and not unfrequently requires from three to four gallons of fluid daily. Through the recommendation of an Indian he has lately found considerable relief from his incessant thirst by drinking water liberally diffused with vinegar.

He has made several ineffectual attempts to dislodge the "varmint" by starvation and the free use of stimulants. On one occasion he abstained from both food and water for three days, in the hope of bringing the occupant to some sort of terms. The first day, the snake became uneasy, the second boisterous, and the third furious, but still the man held out. At the end of the third day, however, his snakeship commenced an attack upon the walls of his prison, with what appeared to be a tolerably full set of teeth, and the result was an immediate supply of food more agreeable to both parties. As may be supposed, the man is reduced to a perfect skeleton under the extreme torture of mind and body preying upon him night and day, but he does not despair of finding a surgeon in the city sufficiently skillful to make an incision in the abdomen and remove the reptile. We have read of similar cases, but this is the first that ever came under our own observation—and we hope it may be the last, for we have felt "all-overish" ever since.

East Indian Jugglery.

Madame Pfeiffer, in her "Second Journey Round the World," gives the following description of certain unexplainable feats of jugglery witnessed by her whilst she was sojourning in the East Indies: "At the close of the entertainment, the performance of Hercules was really curious in its way. He appeared with nothing on but a pair of drawers, and a cord was passed around his neck, and with this his hands and arms were so firmly tied behind him that he could not make the smallest movement. He came to us to have the knots examined, and then he crept under a high covered basket, beneath which various garments were placed; and after the lapse of a few minutes the basket was lifted up, and the Hercules made his appearance completely clothed in them. Then he crept again under the basket, and came out without them, but holding the cord with all its knots fast in his hands, and so forth. All this would, of course, have been nothing in a theatre, where assistance might have been given him, but this was in a meadow, where no assistance was possible. One of the gentlemen present offered him twenty-five rupees for his mystery, but he declined the offer."

The Cashmere Goat—Its Introduction into America.—It is not, as yet, generally known that the Thibet goat, from whose wool the famous Cashmere shawls are made, has been introduced successfully into the United States. This enterprising undertaking was achieved a few years since, after many difficulties, by Dr. J. B Davis, of Columbia, S. C., at that time employed by the Ottoman Porte in experimenting on the growth of cotton in the Sultan's dominions. Dr. Davis succeeded, at vast expense, in securing eleven of the pure breed, which, on his way home, he exhibited in London and Paris. Since that period the goat has been introduced from South Carolina to Tennessee, where it is said to thrive. The value of a flock may be estimated from the fact that no real Thibet goat has ever been sold for less than a thousand dollars. This enormous price, moreover, is not a speculative one, for no fleeced animal has wool of such fineness, softness and durability. The wool of all the Thibet goats in Tennessee, for example, has been engaged at New York, this year, at eight dollars and a half a pound, the purchasers designing to send it to Paisley, in Scotland, in order to be manufactured into shawls.—*Exchange.*

The Vegetable Serpent.—A new organization of nature, being pronounced by naturalists the connecting link between animal and vegetable life, has been found in the interior of Africa, in the form of a serpent with a flower for head. This singular freak of nature is spotted in the body, drags itself along, and the flower forming its head is bell-shaped, and contains a viscid fluid. Flies and other insects, attracted by the smell of the juice, enter into the flower, where they are caught by the adhesive matter. The flower then clooses, and remains shut until the prisoners are bruised and transformed into chyle. The indigestible portion, such as the head and wings, are thrown out by aspiral openings — The vegetable serpent has a skin resembling leaves, a white and soft flesh, and instead of a bony skeleton a cartilaginous frame, filled with yellow marrow. The natives consider it a delicious food.

THE DAILY UNION.

East Indian Archipelago.

A very instructive and readable book has lately been issued from the press, entitled "The Prisoner of Weltevreden, and a Glance at the East Indian Archipelago." The author is Capt. Walter M. Gibson, who was some time ago arrested and imprisoned at Weltevreden, and afterards escaped. Even now he has pending a demand for redress.

The resources of this paradise of earth are but eginning to be developed, owing mainly to the xceeding jealousy with which the Dutch regard he intrusion of outside barbarians. The New York *Commercial Advertiser*, which gives a brief eview of the work, remarks that Capt. Gibson s not a skillful writer—his energy and enthusiasm are more remarkable than his judgment; and to add to the evils of a defective style, he as rendered some portions of his narrative very obscure by the introduction of far-fetched allegory, which the illustrations are scarcely sufficient to explain. Still the book is a very entertaining one, and, for example, read what he says of

THE ORANG-KUBUS, OR HAIRY MEN OF SUMATRA.

I got a glimpse, amid a thick bower of foliage, at a height of about eighty feet, of a dark brown form, seeming to me as large as a human being; and when Bahdoo saw it, he cried out, "orang kubu! orang kubu!"

I raised a shout, and we all cried out at the top of our voices. I struck at some low drooping limbs with the pike in my hand; and then we heard rustles and leaping sounds at other points in the great tree tops near the form we had seen; this one shifted, slid down a limb, came nearer to view, and then we could partly see a very human-like form, holding a little creature with a very human-like face, peering down upon us.

The sailor had raised the carbine and was about to fire, when I bid him stop; it seemed like murder to shoot at that human face, for I had heard something of wild and hairy faces, roaming in the forest not far from the waters of Palembang. I again raised a shout—Bahdoo made a peculiar piercing cry, and again the creature moved; it leaped, others leaped, and the huge tree shook. Downward came the sounds, leaping, rustling, crashing, then dark bodies shot before us, down, plunge into the creek.

We stood with weapons grasped, expecting an attack; but, after hearing a quick flounder and splash in the water, up sprang five or six large creatures, for a moment but dimly seen, then up the bank and away into the thick forest on the other side.

Three-fourths of the day was now gone, and I had seen enough for one day's excursion. The boat was put about, and rowed quickly down the canopied stream—pulled with hands again through the narrow neck, where the leafy tops brushed our backs. Our fatigue felt lightened when we shot out of the leafy cavern into the warm daylight on the main stream we had left; and our increasing fatigue was all forgotten when, upon turning the bend of the stream into the Moosee, we beheld the graceful, golden tipped spars of the Flirt walking up among the towering tree tops.

A light breeze had risen, filling the clipper's main and foretop sail, with which she walked away from the lumbering bark, that crept slowly behind, with all sails set. It was sweet, after the [illegible] and adventure, to sit upon my quarter [illegible] the cool wafts of air that blew [illegible] woods and played with the

ward to me by many Arab and Chinese traders I have met with. The Kubus deposit the gum they collect, and other articles to exchange, in a certain place, when traders are in the neighborhood; then they strike with a club upon a suspended hollow log, called *taboh* by the Malays, making a loud, drum-sound—and run off back into the recesses of the forest. The traders come to the spot, take away the gum, and leave what they think proper. After they have gone, the Kubus cautiously venture out of the thicket, and carry off what has been left for them. Sometimes this mode of barter is reversed—the traders depositing trinkets and cloths—then beat a gong, and retire; whilst the wild men come and take away what has been offered, and honestly and generously leave all that they have got of gum or other articles. Thus the chief material for the purifying incense used in the ceremonial of the Church of Rome is gathered by these rude hands.

Marsden, who resided many years on the western coast of Sumatra, in his account of the aborigines of the island, says that he had heard of two species of people, dispersed in the woods, and avoiding all communication with the other inhabitants; these were the orang Kubu, and the orang Gugar: the former being, as he understood, very numerous on the south-east coast between the Palembang and Jambee territories. He speaks of having heard of several that had been caught and put to work as slaves; and of a young Kubu female that was captured by a man in the Laboon country. He says that the Gugars are much scarcer than the Kubus, differing in little, but the use of some uncouth kind of speech, from the orang utan of Borneo—they being entirely covered with hair. But Marsden is rather skeptical about the existence of these beings of doubtful humanity.

You will have an opportunity when at Palembang, said the Dutch officer, to learn something more definite about these creatures; and may probably see some of them in the possession of the old pensioned Sultan, who resides there. I did learn much more about these wild people at Palembang and at Batavia, which I shall relate in the course of my narrative.

[illegible] by Legislatio[illegible]

CABIN OF BONES.—In the Placerville *American*, of Saturday, Aug. 16th, we find the following:

1856

On Weber Creek, forty-five miles east of Salt Lake City, is a large cabin literally filled with the bones and carcasses of animals. But how came they there? All will remember the account we gave of a drove of cattle on their way from the States to Salt Lake, last fall, getting snowed in on the mountains, that all but two of the animals and one of the men perished—two men escaping by taking each an animal and making the best of their chances through the deep and rapidly falling snows to Salt Lake.

The third man, after laboring in the snow for a time, determined on returning to the cabin and wait till relief could be sent him, but he perished before it reached him. The starving cattle rushed into the cabin to screen themselves from the cold, and as they fell and died, others made their way in only to perish in their turn and make room for yet others, and this made it what it will doubtless long remain the cabin of bones.

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Discovery of Enormous Fossil Eggs. 1857

The Calcutta *Englishman* says :—The *Mauritian* mentions, on the authority of a Bourbon Journal, that a singular discovery has been made in Madagascar. Fossil eggs of an enormous size have been found in the bed of a torrent. The shells are an eighth of an inch thick, and the circumference of the egg itself is two feet eight inches lengthwise, and two feet two inches round the middle. One, which has been opened, contains eight and a half litres, or about two gallons!—What was to have come out of these eggs? Bird or crocodile? The natives seem to be well acquainted with them, and say that ancient tradition is uniform as to the former existence of a bird large enough to carry off an ox. This is only a little smaller than the roc of the oriental fable, which waited patiently till he saw the elephant and rhinoceras fighting, and then carried them of both at one swoop. Some fossil bones were found in the same place as the eggs, but the Bourbon editor says, he will leave it to the pupils off the great Cuvier to decide to what animal they belong. If they should prove to be the bones of a bird of size corresponding with the eggs, the discovery will indeed be an extraordinary one.

THE CALIFORNIA SILK-WORM.—The Saturnia Ceanethi can now be seen to advantage, in all its metamorphoses, from the cocoon, its first, to the full grown caterpillar, its last state, in the grounds of the San Francisco College, on Bush street, between Mason and Taylor streets. There are upwards of one thousand caterpillars, that will shortly be transformed into cocoons and chrysalides. Those of the public who are interested in this discovery may, on proper application to the establishment named, have an opportunity to examine the insects.—*Bulletin.*

THE GRASSHOPPERS.—These insects have made their appearance in countless numbers near this city, and are consuming vegetables with great rapidity. We have been assured that many of the growing crops near the Partera and Cieneguitas have already been quite destroyed by them. They appear to have a partiality for young bean vines and growing grain. The dry season has doubtless favored the development of the destructive insects.—*Santa Barbara Gazette.*

From the Macon Telegraph.

MR. CISBY: There is a negro woman in Bibb county, who has one hundred and nineteen descendants, and is yet in the possession of all her faculties, except sight—she has been blind for six years.

Sixty-seven of her descendants, as well as herself, are now owned by a gentleman in this county. Another heir owns fifty-two in another county.

The name of the woman is Sena. She was one of three slaves inherited by a lady married in Louisville, Jefferson county, Georgia, in 1801.

I mention this as a fact in slave statistics—from which the inference may be drawn, that negroes are not very hardly used in Georgia, or they would not increase at such a rate.

If you feel a curiosity to see the old lady and her descendants, I will take pleasure in showing them to you, as all live within a few hours' travel of each other. Respectfully yours,

BAY GALL.

Swift Creek, Bibb county, Ga., Feb. 22, 1857.

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The Oldest Man in America.

We find the following communication in the Cassville (Ga.) *Standard*, of the 26th inst.:

Mr. Smith: A recent notice in a New York paper, makes Peter Nassau, a colored man, residing at Woodstock, Vermont, the oldest man in America. He has attained the extraordinary age of one hundred and twenty-six years. Albeit, in this era of short lived humanity, this appears a wonderful accumulation of years—there is in our own Sunny South an example of longevity that considerably surpasses it.

There is now living in Murray county, in this State, on the waters of Holley Creek, a Revolutionary veteran, who has attained the age of one hundred and thirty-four. His name is John Hames. He is known throughout the region in w[illegible] by the appellative of "Gran'sir [illegible] for Grand Sire. [illegible] under date of the 12th of February, in relation to is still a proprietor,) writing from Vera Cruz which paper, Mr. Forsyth, our Minister to Mexico, [illegible] Thus a correspondent of the Mobile *Register*, (of [illegible] by partic[illegible] probably well informed.

[illegible] sion, [illegible] he represents the correct version of the treaty, made this [illegible] are inclined to believe is the correct ver- prove mutually beneficial to the two countries, and is simply a commercial arrangement, which will for a sum of money. Another statement is that it of Lower California, and the Department of Sonora of Mexico, together with the cession to this country vides for an American protectorate over the whole ously represented. One statement is that it pronitely known, and its subjects and terms are variance with the Government of Mexico.

The subject matter of this treaty is not yet defation by this Government, are matters of import- ment of its terms at home, and its speedy ratifica- These precautions would indicate that a conceal- [illegible] was ready to convey it to this country.